CANADIAN OCCUPATIONS

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CARPENTER

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MONOGRAPH 1

REVISED 1957

DEPARTMENT OF LABOUR, CANADA

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REVISED 1957

HON. MILTON F. GREGG, MINISTER
A. H. BROWN, DEPUTY MINISTER

DEPARTMENT OF LABOUR, CANADA

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FOREWORD

During recent years there has been a steadily increasing demand for up-to-date information on occupations.

This demand comes from youth faced with the need of choosing an occupation and of selecting the type of training required; from parents, teachers and other counsellors; from workers shifting to other occupations; from employment service officers; from directors of personnel and union officials, and from other quarters.

This series of monographs and an accompanying series of pamphlets, the latter containing similar information in a condensed form, are attempts to meet this demand. These publications are designed for general use and cover a wide range of occupations, including professions. They indicate, among other things, the nature of the occupation or group of occupations, entrance and training requirements, working conditions and opportunities in each.

The staff of the Occupational Analysis Section has prepared this series with the generous assistance of representatives of management, trade unions and professional associations. The co-operation of the Unemployment Insurance Commission, the Vocational Training Branch of the Department of Labour, and the Dominion Bureau of Statistics is gratefully acknowledged.

Acknowledgment is also made of the assistance obtained from numerous publications on occupations prepared in Canada and in other countries.

DIRECTOR,
Economics and Research Branch,
Department of Labour.

April 1957.

CARPENTER

MONOGRAPH 1

Photo: N.F.B.

Carpentry is the basic building trade.

HISTORY AND IMPORTANCE

Carpenters are highly skilled craftsmen who work primarily with wood. Because of the extensive use of wood for building purposes, particularly in North America, carpenters have been traditionally associated with the construction industry, and carpentry is the basic building trade. Other construction tradesmen, such as the plumber, electrician, plasterer and painter, have one special job to do in the building process. The carpenter's skill, however, is needed throughout—from the erection of forms for the pouring of concrete foundations to the installation of finishing trim. As a result, carpenters form by far the largest single group of building tradesmen.

Wood has been used in construction since the earliest times, and carpentry probably dates back to the development of edged metal tools. In Roman times it was a guild craft, the secrets of the trade being handed down from generation to generation. Early carpenters in England and Europe reached a high degree of craftsmanship with hand tools and some of the finest examples of carpentry may be found in old cathedrals built in the Middle Ages.

Although skilled carpenters were included among the early settlers in North America, many pioneers built their own dwellings of logs or rough-hewn timbers taken from the forests. Co-operative building or community "barn-raising" was not uncommon.

Formal apprentice training was not widely practised in North America until recent times, and Canada relied on immigration from Europe for skilled carpenters. In 1928 the Province of Ontario passed the first Apprenticeship Act in Canada, applicable to the building trades only, followed shortly by other provinces. The generally depressed conditions of the 1930's and the emergency created by the Second World War prevented the full development of adequate training programs. Since 1944, however, practically all provinces have actively supported the training of building tradesmen, including carpenters.

The post-war period has been one of tremendous expansion and development, particularly in the construction industry. In spite of a well developed training program for apprentices and the considerable immigration of skilled workers, the supply of qualified carpenters has not, at times, kept pace with the demand.

FIELD OF WORK

The largest concentration of carpenters is in the construction industry. The majority are employed by building contractors to work on housing projects and commercial or institutional buildings. Many are employed on engineering projects to build forms and pouring chutes for concrete, erect scaffolds or to cut and fit heavy timbers for bridges, docks and dams.

Alterations, maintenance and repair on existing structures is another important area of work for carpenters. Many are employed on a regular basis in factories, hotels, hospitals and other institutional buildings where there is a continuous need for this type of work. Others work on their own account, doing repair and alterations for home owners, or for contractors who specialize in such work.

The carpenter is needed in many other industries. He may build and repair railway passenger or freight cars, or other vehicles. He may be employed in mines, where he works on chutes, bins and supporting timbers. To a small extent in Canada, his skills are used in motion picture studios, television studios, and theatres to build scenery and sets. *Ship carpenters* build and install parts of ships and also erect the framework to support the hull during construction. Carpenters, known as *millworkers* or *benchworkers*, work in plants or mills manufacturing pre-fabricated building units, such as doors, windows and cupboards. *Cabinet makers* are actually carpenters who specialize in furniture work, and form a separate though related craft. Another related trade is that of the *pattern maker*, who makes wooden patterns for the manufacture of metal and plastic products.

NATURE OF WORK

General Carpenter (Construction)

The *general carpenter* must be able to carry out all the carpentry duties required in the construction of buildings and engineering projects. He is concerned with laying out, cutting and joining rough or milled lumber that goes into a construction job, although other materials such as composition board, plastic, transite, acoustic tile, asbestos and metal trim are put in place by carpenters.

In addition to skill in the use of carpenters' tools, he must be able to follow blueprints, oral instructions, or proceed from his own sketches and knowledge of building. His work requires an understanding of standard building procedures and regulations, strength of materials, structural design and framing methods. He should be able to estimate and order the material needed for the job. Since construction work is usually the combined efforts of a number of different tradesmen, the carpenter must be familiar with the relationship of his own work with that of other building trades.

The erection of a typical frame dwelling offers a good example of carpentry. Following excavation for the basement, carpenters build and put into place the forms for the concrete foundation. They erect the framework for the entire structure, lay the roof and rough floors, set in place the door and window frames and prepare the outer walls for finishing with board siding, brick veneer or stucco.

In finishing the interior, they fit and hang doors and window sashes, build and erect stairs, lay floors, fit trim around door and window openings, build cupboards and shelves and put on finish hardware.

Specialized Carpentry

The wide variety of work carried out by carpenters in construction has led to a certain amount of specialization within the trade. This tends to be more prevalent in large centres, where the opportunity to do so is greater. There are several types of carpentry in which workers tend to specialize, each requiring, for the most part, the basic carpentry skills of a competent journeyman.

Rough Carpentry applies generally to work done with rough lumber on installations that are temporary in nature, such as

Photo: N.F.B.

Converting a large house into apartments.

concrete forms, pouring chutes and scaffolding. Rough carpentry also includes the installation of sub-floors, wall sheathing and similar work.

Frame Carpentry is the work done in building and erecting the wooden framework of structures, including floor joists, wall studs and rafters.

Form Building is another aspect of rough carpentry, common to all construction projects where forms are needed to give concrete its shape and to support it while it hardens. Concrete is used extensively in dams, viaducts, sewers, tunnels and other projects, as well as in building foundations, floors, reinforced concrete frames, roof slabs and exterior siding. Form builders construct the form panels, move them into place according to blueprint specifications, and secure them with bolts and braces. Form building techniques vary according to type of construction.

Finish Carpentry, as distinguished from rough carpentry, includes the installation of exterior and interior finishing trim, doors, window sashes, cupboards, shelves and finish hardware. The finish carpenter must work with care and skill, as he handles more expensive milled lumber, panelling, moulding, and prefabricated units such as cupboards. Finish carpenters may specialize in certain aspects of finish work such as hardwood floor laying, sash fitting, door hanging, or stair building.

Maintenance Carpentry is necessary to keep buildings in good repair and may include alteration work. The maintenance carpenter performs the carpentry duties necessary to construct and maintain in good repair structural woodwork and equipment in an establishment. He carries out such work as making and repairing counters, benches, partitions, floors, doors and building framework.

QUALIFICATIONS

Carpentry is usually learned through apprenticeship. The minimum entry age is 15 in British Columbia and 16 in all other provinces. In Ontario, Manitoba and Alberta the maximum age is 21 and in Quebec, 25, although some exceptions are made. The remaining provinces leave the upper age open.

The carpenter requires a sturdy physique in order to lift heavy objects and to stand extremes of weather. He has to be able to climb and balance on ladders and scaffolding, to kneel, stoop,

push and pull, and to stand for long periods at a time. He must be able to grasp, lift, carry and handle a great variety of tools and materials, and to operate woodworking machines. His eyesight must be good enough to read blueprints and fine calibration marks on measuring instruments. Speed and manual dexterity are required in his work.

Carpenters must be prepared to buy and care for their own tools. One who is interested in going into business on his own as a master carpenter must be able to understand local building regulations, estimate costs, and deal with clients and workmen in a business-like manner.

PREPARATION AND TRAINING

In most Canadian provinces, the entry and training of persons in the carpentry trade is regulated by the Apprenticeship Branches of the provincial Departments of Labour.

Entrants to apprenticeship require at least grade 9 education in Manitoba and grade 8 in Nova Scotia, New Brunswick, Ontario, Saskatchewan and Alberta. No educational requirement is specified by the other provinces. The preliminary training that a student gets in a technical or vocational school in hand and machine woodworking, mechanical drawing, blueprint reading, practical geometry, physics and other subjects, will improve his chances for acceptance as an apprentice and will help to make his future progress more certain.

The special pre-apprenticeship training classes provided for returned veterans after the Second World War demonstrated the value of this type of training prior to entry into apprenticeship. As a result, a number of provinces have now organized similar classes of about six months' duration for the training of prospective apprentices.

A reduction in the apprenticeship period may be allowed for pre-apprenticeship training or other related training or experience.

Apprenticeship Training

Normally the apprenticeship period lasts four years, during which time the apprentice works for an employer and receives training on the job under the guidance of a journeyman carpenter. Conditions of training are laid down in a written agreement

(indenture). A period of probation, usually three to six months, allows for cancellation of the agreement if the arrangement proves to be unsuitable. Periodic trade tests are being used more and more during training to determine the proficiency of the apprentice.

Photo: N.F.B.

Vocational school training is a good preparation.

During training, the apprentice acquires the manual skills required in the performance of his duties. He gains a knowledge of the qualities and uses of wood and other materials and learns how to plan his work and carry it through to completion in an efficient manner. He also must acquire a thorough understanding of construction processes and the relationship of his own work with that of other building trades.

In addition to on–the–job training, apprentices in most provinces are usually required to attend trade courses at a provincial or municipal vocational school. These courses, which may be full-time or part-time, provide additional instruction in the practice and theory of the trade. In most provinces apprentices attending full-time classes are paid a living allowance, supplemented, in some cases, by the employer.

The following is a brief summary of the provincial requirements for class–room instruction during apprenticeship:

Newfoundland	— evening classes only.
Nova Scotia	— 6 weeks per year for 4 years.
New Brunswick	— 8 weeks per year for 3 years, preceded by 1 year of pre-employment training.
Ontario	— 10 weeks per year for 2 years.
Manitoba	— 6 or 8 weeks during the first or second years, 8 weeks during the second or third years, 4 weeks during the last year.
Saskatchewan	— 6 weeks per year for 3 years.
Alberta	— 8 weeks per year for 4 years.
British Columbia	— 4 weeks per year for 4 years.

In some provinces, where it is difficult for apprentices to attend full–time classes, the equivalent may be obtained in evening classes.

Correspondence courses are available for those who are unable to attend a vocational or technical school and may also be used to supplement class training. Home study courses of interest to carpenters are listed in Appendix I.

After completing apprenticeship and trade tests satisfactorily, the apprentice is granted a journeyman's certificate and may take his place in the trade as a qualified carpenter.

Apprenticeship in Quebec

In Quebec, apprenticeship programs are conducted by Apprenticeship Commissions, each of which controls apprenticeship in its

own area. Apprentices are not ordinarily indentured to an employer, but they are required to register with the Apprenticeship Commission in their area.

The beginner, if he chooses, may go directly into the trade and serve a four-year training period. A more desirable way, and one that is encouraged by apprenticeship officials and employers, is for the prospective apprentice to first prepare himself in one of the pre-employment classes. These classes, provided at special schools conducted by Apprenticeship Commissions in Montreal, Sherbrooke, Chicoutimi, Hull and Quebec, are of about six months' duration (ten months in Hull), and the time spent is applied toward a reduction of the apprenticeship period. Graduates of pre-employment classes are preferred by employers and may start at higher rates of pay than those who do not have the benefit of previous training.

While working on the job, apprentices are encouraged to take evening instruction in classes operated by the Apprenticeship Commissions, or in regular provincial technical or vocational schools. Attendance at these classes may also shorten the apprenticeship period.

At the end of training, all apprentices in Quebec are trade tested, and if successful, are given a "Competency Card" denoting journeyman status.

ENTERING THE OCCUPATION

Application for apprenticeship training may be made directly to the local carpenters' union or to a building contractor. Officials of the National Employment Service, local apprenticeship authorities and school placement officers can also assist individuals in locating openings for apprenticeship. Local newspapers may carry advertisements for carpenters and apprentices in their employment columns.

EARNINGS

The following table presents the latest available figures on wage rates for carpenters. Wage rates change frequently. To keep this information current, the reader should refer to local employers, union officials, newspaper employment ads, and government publications such as Wage Rates and Hours of Labour in Canada, *Department of Labour, Canada.*

HOURLY RATES OF PAY
CARPENTERS IN CONSTRUCTION (BUILDING AND STRUCTURES ONLY) OCTOBER 1956

St. John's, Nfld.	$1.53	Peterborough	$1.75
Charlottetown	1.20	Toronto	2.45
Halifax	1.77	Brandon	1.80
Sydney	2.00	Winnipeg	2.05
Moncton	1.60	Prince Albert	1.85
Saint John	1.58	Regina	1.95
Drummondville	1.45	Calgary	2.10
Montreal	1.90	Lethbridge	1.90
Quebec	1.60	Vancouver	2.25
London	2.25	Victoria	2.28
Ottawa	1.92		

Source: Department of Labour, Canada

Carpenters are paid on an hourly basis. The normal work week ranges from 40 to 44 hours, with extra pay for overtime work. Rates of pay, hours of work and charges for overtime are generally set by local agreement. The apprentice's pay varies from 30 to 50 per cent of the journeyman's rate during his first year as an apprentice to 70 to 90 per cent during his final year.

ADVANCEMENT

The usual line of promotion is from apprentice to journeyman. If he shows the required ability to handle men, the journeyman may become a foreman. A foreman may in time be advanced to the position of construction superintendent. It must be noted, however, that there are relatively few positions at the supervisory level.

Some journeymen carpenters may enter into business for themselves by becoming sub-contractors and eventually contractors, or by opening a woodworking shop.

ADVANTAGES AND DISADVANTAGES

The qualified carpenter is a true craftsman, and enjoys the prestige of belonging to a recognized and respected group of workers who are making an important contribution to the national economy. There is variety in the work, and each job provides many opportunities for developing and improving trade skills. There is satisfaction in seeing one's work take shape, and carpenters may point with pride to the structures they have helped to build.

There is also the prospect of establishing one's own business as a contractor, or of obtaining positions of responsibility in construction work. The 1951 census showed that about 21,000 carpenters were employers or self-employed.

Vacations with pay are provided in most localities, allowances being paid by the employer in the form of stamps that may be cashed in for holiday pay.

Working outside and exposure to all kinds of weather are involved in the work. Falls from scaffolds and injuries from tools or falling material are occupational hazards that can be greatly reduced by exercising a reasonable amount of care. In the event of injury while on the job, Workmen's Compensation benefits provide financial compensation and medical attention.

There may be loss of working time owing to winter layoffs and changing from job to job. In such cases, however, unemployment insurance benefits provide some continuity of income.

Photo: N.F.B.

The foreman plans the next step.

TRENDS

Number in the Occupation

According to the 1951 Census there were about 130,000 carpenters in Canada, an increase of approximately 38 per cent over the 1941 figure. It should be kept in mind, however, that this total included many partly qualified carpenters. Following is the provincial distribution of carpenters in 1951:

Province	Number of Carpenters	Per Cent of Total
CANADA	129,045	—
Newfoundland	4,573	3.5
Prince Edward Island	898	0.7
Nova Scotia	6,943	5.4
New Brunswick	4,615	3.6
Quebec	39,881	30.9
Ontario	39,149	30.3
Manitoba	6,952	5.4
Saskatchewan	4,176	3.2
Alberta	8,879	6.9
British Columbia	12,979	10.1

Industrial Distribution

The following table, based on the 1951 Census, shows the distribution of carpenters by industry:

Industry	Number of Carpenters	Per Cent of Total
Construction	86,260	67.0
Manufacturing	21,704	16.9
Service	8,176	6.3
Primary Industries	3,827	3.0
Other	8,751	6.8

Seasonality

Maintenance and repair work usually continues on a year-round basis. Construction work, on the other hand, is greatly affected by seasonal changes. In the past few years winter construction has been noticeably increased by the use of more efficient

methods of planning and carrying out building operations, thus extending the work year of skilled building tradesmen. According to the 1951 Census, carpenters worked an average of 40.2 weeks per year, compared with 35.3 in 1941. In all probability, the work year of the carpenter has been further extended since 1951.

Future Prospects

The main source of employment for the carpenter is construction work, and his future will depend largely on what happens in this industry.

The construction industry is very sensitive to economic conditions—it has thrived in prosperous times and declined sharply in periods of recession. Since the Second World War, however, Canada has experienced an unprecedented period of development, of which construction work has almost become a symbol. Prospects for continued economic growth are bright, and construction activity will probably remain high.

Within the construction industry, the largest field of employment for carpenters is in structures where wood and wood substitutes are widely used, such as houses, offices, factories and schools, but particularly houses. In 1955, building construction accounted for 64 per cent of all construction work. About one-half of the building construction was in house-building alone.

If there is a significant reduction in house-building, it is likely that the demand for carpenters would be adversely affected, although the decline might be offset to some extent by an increase in industrial and commercial building. The future building program, particularly residential building, will depend to a large extent on the availability of mortgage funds.

There is still a backlog of demand for houses, buildings, and structures of all kinds. Expected increases in population, a rising standard of living, and the development of our natural resources will strengthen this demand. In addition to municipal programs of slum clearance and reconstruction there is also maintenance work required on existing structures. In view of all these factors, the probability is that, over the long run, there will be a strong demand for skilled carpenters to help carry out the construction program of a growing Canada.

REFERENCES

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Ministry of Labour and National Service, London, England, "Choice of Careers", New Series No. 25, *The Carpenter and Joiner* (1951).

The Guidance Centre, Ontario College of Education, Toronto, Monograph, *Carpenter* (1955).

Michigan State Employment Service, Detroit, Occupational Guide, *Woodworking Occupations*, *Carpenters* (1950).

B'nai B'rith Vocational Service Bureau, "Occupational Brief Series", *Careers as Carpenter and Painter* (1954).

APPENDIX I

The catalogue *Canadian Vocational Correspondence Courses* lists 123 home study courses in various vocational subjects, and can be obtained by writing to your provincial Department of Education or to the Canadian Vocational Training Branch, Department of Labour, Ottawa. The following courses are listed in this catalogue:

Carpentry I, Ontario. — 20 Lessons — Fee $10.00.
Prerequisite — Grade VIII Mathematics.
Prepared for — Tradesmen.
Available from — Director, Correspondence Courses Branch, Department of Education, Toronto 5, Ontario.

Frame House Construction, B.C. — 20 Lessons — Fee $10.00.
Prepared for — High school students or adults.
Available from — Director of High School Correspondence Instruction, Weiler Building, Victoria, B.C.

Two courses are published in French and may be ordered from the Director, Correspondence Course Bureau, 506 St. Catherine St. East, Montreal 24, Quebec:

Carpenter's Square, Que. — 12 Lessons — Fee $8.00.
Prerequisite — Elementary education.
Prepared for — Tradesmen.

Elementary Joinery, Que. — 15 Lessons — Fee $10.00.
Prerequisite — Elementary education.
Prepared for — Apprentices and journeymen.

LOCAL INFORMATION

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"CANADIAN OCCUPATIONS" SERIES

Monographs and Pamphlets

The monographs listed below, accompanied by pamphlets, except in the case of numbers 12, 13 and 39, have been published to date.

(1) Carpenter
(2) Bricklayers and Stone-Masons
(3) Plasterer
(4) Painter
(5) Plumber, Pipe Fitter and Steam Fitter
(6) Sheet-Metal Worker
(7) Electrician
(8) Machinist and Machine Operators (Metal)
(9) Printing Trades
(10) Motor Vehicle Mechanic
(11) Optometrist
(12) Social Worker
(13) Lawyer
(14) Mining Occupations
(15) Foundry Workers
(16) Technical Occupations in Radio and Electronics
(17) Forge Shop Occupations
(18) Tool and Die Makers
(19) Railway Careers

Careers in Natural Science and Engineering: (20-35, one booklet)

(20) Agricultural Scientist
(21) Architect
(22) Biologist
(23) Chemist
(24) Geologist
(25) Physicist
(26) Aeronautical Engineer
(27) ——
(28) Chemical Engineer
(29) Civil Engineer
(30) Electrical Engineer
(31) Forest Engineer and Forest Scientist
(32) Mechanical Engineer
(33) Metallurgical Engineer
(34) Mining Engineer
(35) Petroleum Engineer

(36) Hospital Workers (other than Professional)
(37) Draughtsman
(38) Welder
(39) Careers in Home Economics
(40) Occupations in the Aircraft Manufacturing Industry
(41) Careers in Construction

Filmstrips

The Department of Labour has prepared, to date, the following occupational filmstrips in collaboration with the National Film Board. A manual has been prepared as an accompaniment to each filmstrip. These may be purchased from the National Film Board, Box 6100, Montreal, or from any one of its regional offices.

Plumber, Pipefitter and Steamfitter
Careers in the Engineering Profession
The Social Worker
Technical Occupations in Radio and Electronics
Bricklayer and Stone-Mason
Printing Trades
Careers in Natural Science
Careers in Home Economics
Motor Vehicle Mechanic
Mining Occupations
Draughtsman
Careers in Construction

DEPARTMENT OF LABOUR

Economics and Research Branch

CANADA, 1957

OTTAWA
EDMOND CLOUTIER, C.M.G., O.A., D.S.P.,
QUEEN'S PRINTER AND CONTROLLER OF STATIONERY.

CANADIAN OCCUPATIONS

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CARPENTER

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MONOGRAPH 1

DEPARTMENT OF LABOUR, OTTAWA

CANADIAN OCCUPATIONS

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CARPENTER

MONOGRAPH I

HON. HUMPHREY MITCHELL, MINISTER
ARTHUR MACNAMARA, C.M.G., LL.D., DEPUTY MINISTER

DEPARTMENT OF LABOUR, OTTAWA

FOREWORD

During recent years there has been a steadily increasing demand for up-to-date information on occupations.

This demand comes from youth faced with the need of choosing an occupation and of selecting the type of training required; from parents, teachers and other counsellors; from workers shifting to other occupations; from employment service officers; from directors of personnel and union officials, and from other quarters.

This series of monographs and an accompanying series of pamphlets, the latter containing similar information in a condensed form, are attempts to meet this demand.

These publications represent an expansion of an earlier series issued by the Department of Veterans Affairs to assist members of the armed forces returning to civilian life following the end of the war. These current series, designed for general use, cover a wide range of occupations, including professions. They indicate, among other things, the nature of the occupation or group of occupations, entrance and training requirements, working conditions and opportunities in each.

The monographs have been prepared by our research staff working on occupations, with the generous help and advice of officials of the Unemployment Insurance Commission, Vocational Training Branch, and Bureau of Technical Personnel of the Department of Labour, Dominion Bureau of Statistics, Provincial Departments of Education and of Labour, employers' associations, trade unions, professional associations, and other government and non-government bodies.

Grateful acknowledgment is made of this assistance and that obtained from numerous publications on occupations prepared in Canada and in other countries.

DIRECTOR,
Economics and Research Branch,
Department of Labour.

January, 1949.

CARPENTER

This is the first of seven monographs dealing with the principal construction trades, sometimes called "building trades". Part I, below, presents material which concerns all these crafts. Part II deals specifically with carpentry. The other monographs which will follow are:

2. Bricklayers and Stone Masons
3. Plasterers
4. Painters and Decorators
5. Plumbers, Pipefitters and Steamfitters
6. Sheet-metal Workers
7. Electricians

It is intended that Part I be used as background information for all these occupations, and it has been found convenient to incorporate it in the first monograph.

PART I

The trades under discussion are those for which there has been a steady demand for apprentices, a demand only temporarily met by veterans whose training has been accelerated. The name "Construction Trades" is somewhat misleading, since the proportion of members of each craft engaged in the construction industry varies considerably, as will be shown in the following table.

"CONSTRUCTION OCCUPATIONS" BY INDUSTRY, 1941

	Construction	Primary	Manufacturing	Transport & Communication	Trade & Commerce	Service
Carpenters	78.6%	1.3%	16.3%	1.9%	†%	1.1%
Brick & Stone Masons	89.7	†	8.4	†	†	†
Plasterers & Lathers	98.2	†	1.2	†	†	†
Painters, Decorators and Glaziers	72.4	†	21.9	1.6	1.5	1.8
Plumbers & Pipefitters	65.7	3.3	24.9	2.7	1.1	2.1
Sheet-metal workers and Tinsmiths	13.7	†	81.3	1.4	2.0	†
Electricians & Wiremen	25.5	4.4	55.4	7.1	3.1	3.7

† = negligible, less than 1%.

The source of this and subsequent statistical data is the Dominion Bureau of Statistics, unless otherwise indicated.

Since the employment of these tradesmen is affected by conditions within the industries listed, it is necessary to consider trends in these latter, giving in particular the most pertinent data concerning the construction industry, which in 1941 employed 98.2% of plasterers and lathers, 89.7% of bricklayers and stone masons, 78.6% of carpenters, 72.4% of painters, decorators and glaziers, and 65.7% of plumbers and pipefitters. It is plain that electricians and wiremen and sheet-metal workers are more dependent on conditions in manufacturing, and that electricians have the widest industrial distribution.

Photo: N.F.B.

Converting a Large House into Apartments

The construction industry, being the only common field of employment, is dealt with in this initial monograph; discussion of the branches of manufacturing and other industries affecting the various trades is reserved for the monographs on each trade.

DIVISION OF THE CONSTRUCTION INDUSTRY

There are two major divisions of activity in this industry—Building and Engineering construction. The former covers all on-site work on residential, commercial, industrial, institutional and other building; the latter consists of work done on streets, highways, bridges, watermains, dams, reservoirs, central electric stations and transmission lines, docks, and other engineering projects. Except in the case of work of regular employees on railways, telegraph systems and other public utilities, maintenance and repair work is normally included.

IMPORTANCE IN CANADIAN ECONOMY[1]

In 1946 this industry accounted for 6.7% of the total net production in Canada. In that year the value of all construction work was $583 million; in 1947 it had risen to over $803 million. These figures contrast with an average for the years 1937, 1938 and 1939 of $230 million.

Approximately $293 million was paid in wages and salaries in 1947, the 120,500 wage-earners receiving $233.5 million, and the 28,800 salaried workers $59.8 million.

Not only does this industry employ one in every thirty-three workers in Canada, but it contributes to the employment of many engaged in the primary and secondary production of building materials. Probably more than half the preparatory work necessary in construction is carried on in factories away from the site.

THE WORKING YEAR

Climatic conditions in Canada formerly imposed severe restrictions on building activities. The industry has in recent years given much attention to planning

1. Statistics for 1947 are preliminary estimates only.

methods of extending the working period, and the application of these methods has made it possible to make fuller use of the services of the craftsmen employed, and at the same time ensure to these a considerably larger annual income than was formerly obtainable.

BETWEEN THE WARS

The marked sensitivity of the construction industry to economic conditions in the past is evidenced by what happened in the prosperous 1920's and the depressed 1930's.

The tabulation below will show to some degree which trades were most affected by these conditions. It is significant that both bricklayers and plasterers showed a falling-off in numbers from 1931 to 1941, though by the latter year there had been a greatly increased demand for these workers, as well as for carpenters and painters, for war-time construction, and for sheet-metal workers in war industry.

PERCENTAGE CHANGES IN NUMBERS EMPLOYED IN CONSTRUCTION OCCUPATIONS DURING EACH OF LAST TWO INTER-CENSUS PERIODS

Construction Occupations	Percentage Changes in Numbers Employed	
	From 1921 to 1931	From 1931 to 1941
	%	%
Carpenters	+10	+15
Brick and Stone Masons	+19	−18
Plasterers and Lathers	+98	−21
Painters, Decorators and Glaziers	+53	+20
Plumbers and Pipefitters	+40	+17
Sheet-Metal Workers	#	+44
Electricians and Wiremen	+70	+11
TOTAL LABOUR FORCE	+26	+ 7

Numbers not available in Census for 1921.

The decrease in the "trowel trades" in the second decade is very noticeable. Little permanent building was being done in 1941. Housing legislation passed after 1934 by the federal government helped to ease conditions in the industry generally; between 1938 and 1946 loans aggregating close to $160 million were approved in this connection.

A further index to fluctuations in construction activity is shown by the following data:

VALUES OF BUILDING PERMITS TAKEN OUT IN 35 CITIES AND INDEX NUMBERS OF EMPLOYMENT IN BUILDING CONSTRUCTION

Year	Building Permits	Annual Index Numbers of Employment in Building Construction (1926 = 100)
	$(000,000)	
1921	101	62
1924	113	71
1926	143	100
1929	214	135
1933	20	39
1937	50	60
1941	84	140
1943	52	160
1944	83	95
1945	117	102
1946	225	146

Comparable figures are not available on engineering construction, but it is common knowledge that this was at a very low ebb in the 1930's.

WHY APPRENTICES ARE NEEDED

It is quite obvious that the conditions of the 1930's were not such as to encourage Canadian youths to enter the building trades. There had never been a great intake of the native-born to these crafts, since there was, in the great flow of immigrants before 1914, and in the lesser flow of the 1920's, a considerable supply of fully trained craftsmen who kept the industry reasonably well reinforced. The cessation of immigration, and the actual emigration back to Britain of appreciable numbers of skilled tradesmen in the 1930's, left the industry short of its post-war urgent requirements in man-power. The war gave no opportunity to add young men to the crafts. Provision had meantime been made for apprenticeship legislation in most of the provinces, but this has not operated long enough for its effect to be a marked one as yet. The enrolment of veterans, with special courses of training and curtailed apprenticeship time, has brought a considerable number into the trades, but this recruiting is still not adequate to meet present and potential demands.

In 1946 the National Joint Conference of the Construction Industry[1] estimated that, on the basis of the accepted ratio of apprentices to mechanics (journeymen), approximately 20,000 apprentices would be required over a four-year period to provide an adequate working-force of skilled men for the annual programme facing the industry. A breakdown by province and by trade was made as follows:

TRADES	4-year Total*	N.S.	N.B.	P.E.I.	QUE.	ONT.	MAN.	SASK.	ALTA.	B.C.
Carpenter....	7,600	760	251	25	2736	2382	284	173	340	651
Bricklayer...	738	73	24	2	266	231	28	17	33	62
Plasterer.....	650	65	21	2	234	204	24	15	29	54
Painter......	5,000	500	165	15	1800	1577	188	115	230	420
Plumber & Steamfitter	2,800	280	92	8	1001	878	105	64	128	235
Sheet-Metal Worker....	600	60	20	2	216	188	22	14	28	50
Electrician...	3,300	330	109	9	1188	1035	123	76	151	277

* To ascertain annual recruitment divide totals above by 4.

The quotas above did not include the intake of veterans, trained or in training in these occupations, numbering approximately 15,000 at the end of 1946. The veteran entries were looked upon as taking up the backlog of accumulated requirements of the war years.

An important factor to be considered is that of replacement, necessitated by retirement, or death, of craftsmen. The following table will give some indication of this:

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[1] The National Joint Conference of the Construction Industry was established in 1921, and the 1946 meeting was attended by equal numbers of employers' and employees' representatives. In the former group the Canadian Construction Association, founded in 1919, and representing some 700 general contractors, road builders, trade contractors and suppliers, and 23 Builders' Exchanges, has been prominent. Employees' representatives include officials of the construction craft unions. Between meetings of the Conference continuous activity is carried on by the National Joint Conference Board appointed in 1941. The main purpose of the Conference and its Board has been to deal with various problems confronting the industry, including labour supply, apprenticeship, industrial relations, safety, and providing stable employment throughout the industry.

PERCENTAGE DISTRIBUTION, GAINFULLY OCCUPIED, 1941, BY AGE GROUPS

	24 and under	25-54	55 and over
Carpenters	7.7	62.0	30.3
Brick & Stone Masons	6.4	57.6	36.0
Plasterers & Lathers	6.6	66.2	27.2
Painters, Decorators and Glaziers	11.6	67.3	21.1
Plumbers & Pipefitters	13.7	69.3	17.0
Sheet-Metal Workers	21.9	63.8	14.3
Electricians & Wiremen	16.6	73.4	10.0
All occupations (except agriculture)	16.7	65.2	18.1
All construction occupations	9.5	65.0	25.5

It will be seen that brick and stone masons, carpenters, and plasterers and lathers had in 1941 a much higher proportion in the "over 55" group, and that all the trades except sheet-metal workers listed had a smaller proportion in the youngest group, than had the non-agricultural labour force as a whole. Carpenters and the "trowel trades" were most obviously short of young men.

WHAT OF THE FUTURE?

Mention has already been made of important changes taking place in methods of planning building operations, and of their effect in prolonging the working year.

Technological changes of importance are also having an influence on the trades. There is a greater variety of material; structures are becoming more complex; air-conditioning and new heating methods are being introduced. New materials include spun glass for insulation, duro-glass for store fronts, fibre board for walls, and glass brick.

Construction operations are becoming more mechanized. Illustrations of this are mechanical excavation and concrete mixing, and the wider use of hoisting machinery, electric tools such as hand saws, radial saws, sanders and drills, and mechanical pipecutters and paint sprayers. Labour-saving devices have also been introduced in the handling of materials on site and off site.

Pre-cutting and pre-assembling of materials is increasing, and may result in a redistribution of workers in some trades between on-site work and shop work.

QUALIFYING FACTORS

The following are some variable factors which affect the construction trades:

(a) Growth of population, natural and by immigration, creating a continuing demand for more housing.

(b) Movements of population.

(c) Improvements in existing housing accommodation.

(d) Changes in material costs.

(e) An expansion or contraction of primary and secondary industries.

(f) The backlog of planned public works, federal, provincial and municipal, which should cushion any falling-off in industrial, commercial and domestic building.

(g) Government assistance in long-term financing of housing.

OTHER INDUSTRIES

The table given on Page 3 of this monograph indicates that the employment of a varying proportion of certain of these crafts is in manufacturing. Electricians are the only construction tradesmen of whom any noticeable percentage is engaged in transportation, trade and commerce, and service; the existence of electrically-operated transport systems, of hotels, theatres and office buildings requiring maintenance electricians accounts for this employment.

Electricians, plumbers and a small number of carpenters are required in mines and other primary undertakings.

The major areas of employment for construction craftsmen in manufacturing in 1941, the last year for which figures are available, are set out in the following table. The numbers employed may also serve as the basis for estimating the effects of fluctuations in activities in each branch of manufacturing. The figures may include, in some cases, a varying proportion of workers not fully skilled, since the Census classifications are broad ones. Minor figures are omitted.

EMPLOYMENT OF CERTAIN CONSTRUCTION TRADESMEN IN MANUFACTURING, 1941

CARPENTERS

Boats and canoes	484
Boxes, baskets, barrels	272
Carriages, wagons, sleighs	108
Furniture mfg. & repair, upholstering	1,333
Pulp and paper	491
Saw & planing mill products	2,817
Other wood products	916
Aircraft	755
Automobiles & cycles	366
Boilers, engines, machinery	249
Foundry products	170
Munitions	450
Primary iron products	208
Railway rolling stock mfg. & repair	1,494
Shipbuilding & repair	2,105
Electrical products mfg. & repair	141
Non-ferrous metal, smelting & refining	402
Explosives & ammunition	196
Other chemical products	135
Electric light & power	147
Other manufacturing	1,495
Total (16.3% of all Carpenters)	14,734

BRICK AND STONE MASONS

Pulp and paper	51
Foundry products	55
Primary iron products	153
Non-ferrous metal, smelting, refining	79
Brick and tile	159
Monumental and building stone	47
Other manufacturing	212
Total (8.4% of all Brick & Stone Masons)	756

PAINTERS, DECORATORS AND GLAZIERS

Furniture mfg. & repair, upholstering	424
Pulp and paper	230
Saw and planing mill products	136
Other wood products	91
Aircraft	472
Automobiles and cycles	1,160
Automobiles repair (including garages)	932
Boilers, engines, machinery	243
Farm machinery and implements	97
Foundry products	209
Munitions	195
Primary iron products	160
Railway rolling stock mfg. & repair	668
Sheet metal products mfg. & repair	80
Shipbuilding & repair	394
Other iron products	87
Electrical products mfg. & repair	189
Non-ferrous metal, smelting & refining	124
Glass products	115
Petroleum products	68
Paints and varnishes	228
Other miscellaneous products	1,342
Other manufacturing	933
Total (21.9% of all Painters, Decorators and Glaziers)	8,577

SHEET-METAL WORKERS

Pulp and Paper	63
Aircraft	1,423
Automobiles and cycles	265
Boilers, engines, machinery	226
Farm machinery and implements	83
Foundry products	648
Hardware and tools	111
Munitions	114
Primary iron products	351
Railway rolling stock, mfg. & repair	353
Sheet-metal products " " "	3,663
Shipbuilding & repair	206
Brass and copper products	64
Electrical products mfg. & repair	137
Other non-ferrous products	79
Other manufacturing	515
Total (81.3% of all Sheet-Metal Workers)	8,301

ELECTRICIANS AND WIREMEN

Pulp and paper	789
Aircraft	417
Automobiles and cycles	383
Automobile repair (including garages)	195
Boilers, engines, machinery	271
Foundry products	170
Munitions	303
Primary iron products	398
Railway rolling stock mfg. & repair	340
Shipbuilding and repair	535
Electrical products mfg. & repair	3,151
Non-ferrous metal smelting & refining	390
Other chemical products	186
Electric light and power	3,277
Other manufacturing	1,471
Total (55.4% of all Electricians and Wiremen)	12,276

APPRENTICESHIP

Provincial Apprenticeship Boards, and the respective unions, regulate the admission of apprentices.

Details in the case of carpenters are included in Part II, and for other occupations in the respective monographs.

The National Employment Service provides an agency by which contacts and arrangements may be made, through its network of local offices across Canada.

QUALIFICATIONS

Minimum educational standards are given for each province and each trade, in the respective monographs on the crafts. It cannot be emphasized too much that one or more years of schooling beyond these minimal standards, and a technical course related to the trade selected, are highly desirable, and will prove a distinct advantage throughout the working life.

All these occupations call for a sturdy and sound physique. Few women have entered them.

WORKING PROPRIETORS

During the 1930's the trend towards centralization and the increasing difficulty of carrying on small individual enterprises under depressed economic conditions brought about a decline in the number of working proprietors in these trades. In 1921 they numbered 39,700; in 1931 there was a drop to 38,400 and in 1941 a further fall to 37,600. Post-war conditions have favoured a reversal of this trend, especially in the case of carpenters and painters.

There are few occupations nowadays with opportunities for eventual proprietorship greater than those in this group.

A WORD TO COUNSELLORS

The tendency of many youths to leave school with inadequate education, and to take a "dead-end" job which provides a wage at least temporarily attractive, is a problem all guidance workers face.

The improving conditions in the construction trades, and the value of a skill acquired, not only from a financial viewpoint, but in the satisfaction the performance of expert work gives to the individual, are points which may well offset the relatively low initial wage for apprentices. Moreover, this wage increases periodically, and is in most provinces related directly to that of journeymen, which has followed an upward trend. It might be recalled that apprenticeship is a privilege, a technical education valued in Britain and in other older lands to the extent that payment was for many years customarily made to the master employer for that privilege.

PART II

HISTORY AND IMPORTANCE

Carpentry is one of the world's most ancient crafts. Its origin was a logical outcome of the development of edged metal tools; without it the ships which first navigated great waters would never have been built. The iron age, with its improved tools, developed a degree of craftsmanship in this occupation which set standards since maintained by skilled workers; modern tools have merely speeded the work. In Roman times this was an established guild occupation. As a craft, or "mystery", it has always practised formal apprenticeship, save in North America, where the rough wooden house, result of the great forests the early settlers found, could be built by the "rough carpenters". There seems to be a fair supply of the latter in this country, but a shortage of fine carpenters.

Carpentry is numerically the most important of the building trades in Canada. From the beginning to the end of a building job the carpenter's skill is needed.

TRENDS

The persistence on this continent in the present day of the wooden house, not merely in new regions, but even in cities, and the neglect of formal apprenticeship (especially in the 1930's and in the war years) until very recently, have resulted in continued use of "rough carpenters" in considerable numbers. Thus any statistical information on the craft will include many who are not fully skilled workers.

This is now a "designated" trade for apprenticeship in all Canadian provinces except Prince Edward Island, where, however, legislation exists which could be implemented in this connection.

Number in this Occupation

The actual number of carpenters in Canada is difficult to determine. The 1941 Census listed over 13,000 employers and "own account" workers in this trade, and 77,000

employees. The latter figure included many classed as rough carpenters. The National Joint Conference of the Construction Industry in 1946 worked on an estimate of 55,000 skilled employee carpenters in the construction industry itself. Since there were in 1941 some 19,000 listed by the Census as in other industries, a total of 74,000 employees, plus 13,000 employer and "own account", making 87,000 in all, may well be a reasonably correct figure.

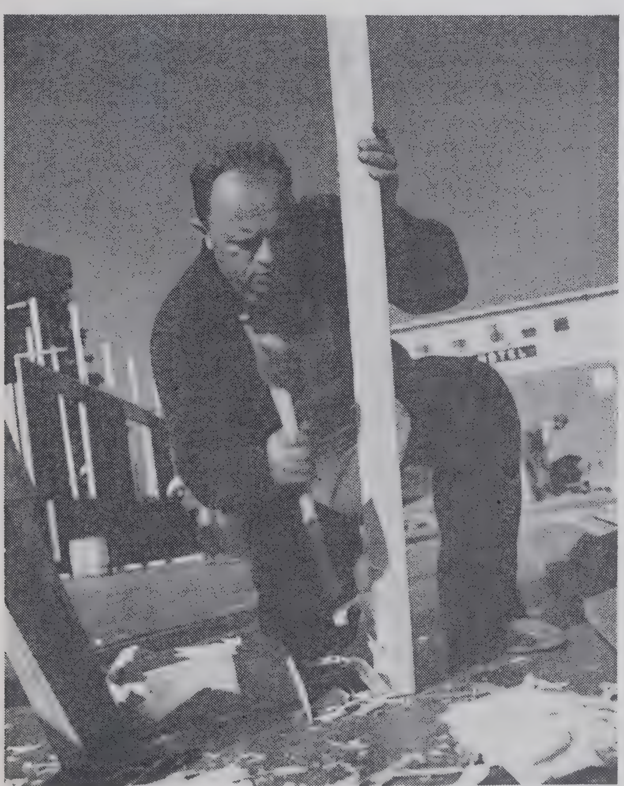

Photo: N.F.B.

Building a New Housing Centre

Carpenters in Canada number approximately 50% of the craftsmen in the building trades.

Age Distribution

For the age group 35 to 64 years there was an increase from 58.07% in 1921 to 60.06% in 1931. While there was a decrease in the 16-19 years group from 4.12% to 3.28%, there is a higher percentage of older-age persons in this trade than in the working population generally. Figures for 1941 would represent an abnormal period, and therefore are not quoted.

Provincial Distribution

A compilation, based on the Dominion Bureau of Statistics Manpower Inventory of 1942, shows the percentage distribution of carpenters: P.E.I. 0.3; N.S. 13.0; N.B. 4.0; Que. 37.9; Ont. 24.2; Man. 3.9; Sask. 2.3; Alta. 5.3; B.C. 9.1.

Industrial Distribution

Of the "carpenters" listed in the 1941 Census, 78.6% were engaged in the Construction Industry, 16.3% in Manufacturing, 1.9% in Transportation and Communication, and 3.2% in other industries.

Growth

Increases in the number in this trade are related more to the activity of the construction industry than to population growth.

Census figures for carpenters are as follows: 1921, 73,528; 1931, 81,264; 1941, 93,756. These increases reflect rather the effect on construction of the early "depression" and early war years than any relation to actual population. The post-war (I) boom had not entirely collapsed in June 1921, when the Census was taken; 1931 was a year in which industry was steadily dwindling; 1941 was a period of accelerated construction of war factories and more or less temporary buildings for the use of the armed forces.

A comparison of the percentage increases of the number of carpenters given with those of population, the labour force and the building trades as a whole is informative on this point.

	Percentage Increases 1921-31	1931-41
Carpenters	10.4	15.0
Population	18.0	10.9
Labour force	26.0	6.6
All building trades	26.1	12.6

The vast amount of urgent wooden construction in the early war years increased the number of carpenters, probably by the addition of many semi-skilled men.

Unemployment

Unemployment of carpenters will generally follow the pattern of the construction industry as a whole.

Weather has been in the past years a restricting factor on employment in the construction industry, the worst months being February and March as a rule. The highest point of employment was usually reached in August or September. New and more efficient methods of planning building operations are having a marked effect in increasing the work year of skilled building tradesmen.

More serious even than seasonal unemployment has been that resulting from cyclical disturbances. Construction activities have fluctuated to a greater degree than those of most other industries.

The 1941 figures quoted above reflect the rapid growth of war construction during the early war years; in 1942 the percentage of construction workers employed on building for war purposes was 61.3.

The post-war impetus to domestic building has been slowed by rising costs and shortages of materials. Public works planned by federal, provincial and municipal authorities, with a view to maintaining a high level of employment, may be expected to give greater stability to the construction industry.

Demand and Supply

In 1946 the National Joint Conference of the Construction Industry made an estimate of a four-year requirement of 7,600 carpenter's apprentices, or 1,900 per annum, and quotas were allotted to the various provinces. This estimate was based on 55,000 journeymen carpenters in the construction industry, and does not take into account carpenters in other industries or the self-employed. Using the all-inclusive total of 87,000 given on Page 15 of this monograph, in the same ratio the annual requirement for new apprentices would amount to about 3,000 and the provincial distribution would be:

P.E.I.	9	Que.	1,080	Sask.	64
N.S.	285	Ont.	945	Alta.	130
N.B.	96	Man.	112	B.C.	255

As of 26th February, 1948, National Employment Service recorded 466 vacancies for carpenters, with 13,455 applicants. The figures for the regions were:

	Unfilled Vacancies	Unplaced Applicants
Maritimes	12	2,404
Quebec	98	4,275
Ontario	126	2,590
Prairies	180	2,279
Pacific	50	1,907

These may be regarded as representing the low point of seasonal employment. They should be compared with those of a busy month.

On September 30, 1948, National Employment Service reports recorded the following for carpenters:

	Unfilled Vacancies	Unplaced Applicants
Canada	1,958	1,653
Maritimes	348	286
Quebec	329	431
Ontario	692	382
Prairies	462	89
Pacific	127	465

In considering these figures it must be remembered that placements are also made through the unions, and that the vacancies do not include all openings. On the other hand "carpenter" applicants registered with the National Employment Service would include a number not fully qualified as such.

Employment Prospects

There is every likelihood that the increased supply of materials will result in an increased demand for carpenters. A counter-acting influence is the cost of materials. It may be reasonably expected that the construction industry will remain active for at least the next three or four years.

It is probable that the semi-skilled "rough carpenters" will be employed, as in the past, where skilled men are lacking. Their work is likely, however, to be more affected by seasonal slackness.

Summary

In view of the limited apprenticeship objective of the National Joint Conference, and of the relatively large number of veterans trained or in training as carpenters, the local situation should be carefully considered. Ratios of apprentices to journeymen, under union control and provincial regulations, have been modified in favour of veterans, but a tightening of these is already taking place in some construction trades, and may be expected in carpentry.

There is a reasonable prospect of employment for a limited number willing to take the training required to become properly qualified as carpenters. A gradual reduction of the "rough carpenter" class is anticipated as the effect of apprenticeship regulations, an innovation in some provinces, becomes appreciated in the industry.

Employment through the years will be conditioned by economic factors, industrial expansion, the extent and nature of public works, and population growth.

DUTIES

There are over sixty classifications under "Carpenter" in the United States Dictionary of Occupational Titles, based on specialization of function.

The following paraphrase, adapted to Canadian practice, of a definition issued by the Industrial Services

Division, United States Employment Service, covers the occupation generally:

A carpenter builds and repairs structures by laying out, cutting, fitting and joining wood or other material such as fibre, cork, plaster, or composition material. He erects the wooden framework of small buildings and other structures; builds scaffolds, concrete forms, and pouring chutes; lays floors; installs interior and exterior trim. He may also install metal fixtures, such as locks and escutcheons. He receives oral instruction, blueprints or written specifications as to dimensions and materials. He may use his own knowledge of strength, quality and use of materials to build a structure, acting on general instructions only, making his own sketches and drawings.

Ships, boats, bridges, dams, stage scenery, vehicles, docks, mine timbering and cofferdams are among the structures other than buildings on which a carpenter may work.

He uses hand tools in most cases, but may employ bandsaws, circular saws, tenoning and mortising machines, and other woodworkers' mechanical equipment.

Cabinetmakers are actually carpenters specializing in highly skilled woodworking, and form an individual craft.

QUALIFICATIONS

Those considering entering this occupation should have a real interest in mechanical operations.

The normal entrance age for apprentices is 16 to 18. In the case of veterans the applicants may be older, but the accent is on youth. In Ontario, Manitoba and Alberta 21, in Quebec 25, are upper age limits, but exceptions to these are made. The remaining provinces leave the upper age limit open.

An education at least to elementary school graduation level plus secondary school courses in mechanical drawing, mensuration, and some physics, are desirable in the

would-be carpenter. Manitoba apprenticeship regulations require Grade IX standing; New Brunswick, Alberta and Ontario, Grade VIII. No academic requirement is specified by the other provinces.

In addition to the manual skills required in performing his duties he must have knowledge of the qualities and uses of woods and other materials, ability to visualize the completed job, to plan his work and to carry it through to completion in an efficient manner. He must know how to read and interpret blueprints and to understand the requirements, not only of his own job, but also of the work to be performed by other tradesmen with whom he must co-ordinate his operations.

The carpenter requires a rugged physique to perform heavy lifting and to stand extremes of weather. Physically he will have to be in condition to stoop, turn, crouch, kneel, pull or push, and to stand for long periods. He must be able to grasp, lift, carry, and handle a great variety of tools and materials, and to manipulate a woodworking machine. A sense of balance is needed in using ladders and scaffolding. He must have eyesight good enough to read blueprints and fine calibration marks.

Speed and dexterity are required in his work. Neatness, cleanliness, and accuracy are essential.

Carpenters must be prepared to buy and care for their own tools.

Those who, after obtaining sufficient skill and experience, intend to operate on their own account must be able to master local building regulations, estimate costs of labour and material, and deal with clients and labour in a business-like manner.

TRAINING

Normal apprenticeship is for four years, regulated by provincial authorities and by the unions locally.

In Quebec the Building Trades Apprenticeship Commission gives accelerated training at its Apprenticeship Centre.

In most provinces school training is combined with apprenticeship for a set period in each year; in some cases correspondence courses for rural apprentices take the place of day or evening classes.

With regard to veterans, Canadian Vocational Training schools gave a six months' course, graduates of which were considered eligible to enter the third year of apprenticeship. Subject to provincial agreement, a similar procedure for civilians is now authorized. Experience in the Armed Forces and elsewhere was assessed locally, in accordance with procedures which vary with the provinces.

Technical school training is assessed according to individual attainment of skills.

ENTRY INTO APPRENTICESHIP

Applications for apprenticeship may be made direct through the local union, but the nation-wide facilities of the Youth Section of the National Employment Service are available in this connection, and will help to make the necessary contacts.

EARNINGS

Minimum rates for carpenters' apprentices, in common with those in the other skilled building trades, were recommended by the National Joint Conference Board in 1946 on the following scale:

1st year	**30%**	**of Journeyman's rate**
2nd year	**40%**	" " "
3rd year	**50%**	" " "
4th year	**70%**	" " "

Ontario alone has adopted these. Increases are on a semi-annual basis in all provinces except Quebec, Ontario and Alberta, which make them annual (although in Alberta, for the first year, they are semi-annual). The ranges for other provinces are:

	%
Nova Scotia	**50 to 90**
New Brunswick	**40 to 80**
Quebec (Montreal only)	**50 to 85**
Manitoba	**35 to 75**
Saskatchewan	**50 to 95**
Alberta	**35 to 90**
British Columbia	**25 to 85**

These rates may be varied locally by agreement.

Journeymen's hourly rates are fixed by local agreement, and are affected by living costs, more or less, and by supply and demand. The following were representative rates in November 1948:

Charlottetown	$ .85	London	$1.35
Halifax	1.20	Windsor, Ont.	1.50
Moncton	1.10	Fort William	1.37
Saint John, N.B.	1.00	Winnipeg	1.35
Quebec	1.00	Regina	1.35
Montreal	1.25	Calgary	1.40
Ottawa	1.30	Edmonton	1.40
Toronto	1.50	Vancouver	1.55
Hamilton	1.40	Victoria	1.40

Hours of work vary according to local conditions and agreements.

ADVANCEMENT

Apprentice to journeyman; a journeyman may advance to foreman, or to sub-contractor on own account; sub-contractor to contractor; foreman to construction superintendent.

RELATED OCCUPATIONS

These include cabinet-making, furniture-making, door and sash-making, stair-building, pattern-making in wood, and cooperage.

There are many interesting jobs such as the making and repairing of violins, sporting equipment, smokers' pipes, furniture, stocks for firearms, and wooden models of ships, aeroplanes, etc. Wooden handles for tools, ornamental household goods such as trays, picture frames and carved wooden figures are other items which might profitably be undertaken by a skilled carpenter in his spare time.

ADVANTAGES AND DISADVANTAGES

The carpenter who has mastered the basic skills of his craft will find that he has still scope for extending these into specialized fields. There is great variety in his work;

each job is an individual one, and its completion cannot fail to give the good carpenter a real satisfaction.

There is, too, the prospect of working into one's own business as a contractor, or of obtaining the responsible position of superintendent of construction.

It is an advantage also to be able to build additions or make alterations and repairs on one's own property.

This occupation shares in the benefits covered by Unemployment Insurance and Workmen's Compensation.

Disadvantages are the effect of weather and business conditions on employment, exposure to weather in much of the work, and the occupational hazards arising from ladders, scaffolds, edged tools, falling material, and machinery.

ORGANIZATIONS

The majority of carpenters are members of recognized unions, usually of a craft nature. Others are members of industrial unions covering all employees in an establishment.

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Audio-Visual Material

Readers desiring information on film sources, other available material, and the organization of local film services may obtain it from National Film Board offices at the following addresses:

British Columbia—535 Georgia St. W., Vancouver

Alberta—University of Alberta, Edmonton

Saskatchewan—Department of Education, Regina

Manitoba—205 McArthur Bldg., Winnipeg

Ontario—86 Bloor St. W., Toronto

Quebec—305 Confederation Bldg., Montreal

Nova Scotia—Department of Education, Halifax

New Brunswick—Provincial Normal School, Fredericton

Prince Edward Island—Department of Education Charlottetown

The catalogue of the National Film Society of Canada 172 Wellington St., Ottawa, gives classified lists of 16 mm. films, many of which deal with occupations.

DEPARTMENT OF LABOUR

Economics and Research Branch

OTTAWA, 1949

OTTAWA
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KING'S PRINTER AND CONTROLLER OF STATIONERY,
1949

CANADIAN OCCUPATIONS

★

BRICKLAYERS and STONE-MASONS

★

MONOGRAPH 2

DEPARTMENT OF LABOUR, OTTAWA

CANADIAN OCCUPATIONS

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HON. HUMPHREY MITCHELL, MINISTER
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DEPARTMENT OF LABOUR, OTTAWA

FOREWORD

During recent years there has been a steadily increasing demand for up-to-date information on occupations.

This demand comes from youth faced with the need of choosing an occupation and of selecting the type of training required; from parents, teachers and other counsellors; from workers shifting to other occupations; from employment service officers; from directors of personnel and union officials, and from other quarters.

This series of monographs and an accompanying series of pamphlets, the latter containing similar information in a condensed form, are attempts to meet this demand.

These publications represent an expansion of an earlier series issued by the Department of Veterans Affairs to assist members of the armed forces returning to civilian life following the end of the war. These current series, designed for general use, cover a wide range of occupations, including professions. They indicate, among other things, the nature of the occupation or group of occupations, entrance and training requirements, working conditions and opportunities in each.

The monographs have been prepared by our research staff working on occupations, with the generous help and advice of officials of the Unemployment Insurance Commission, Vocational Training Branch and Bureau of Technical Personnel of the Department of Labour, Dominion Bureau of Statistics, Provincial Departments of Education and of Labour, employers' associations, trade unions, professional associations, and other government and non-government bodies.

Grateful acknowledgment is made of this assistance and that obtained from numerous publications on occupations prepared in Canada and in other countries.

DIRECTOR,
Economics and Research Branch,
Department of Labour.

March, 1949.

BRICKLAYERS and STONE-MASONS

HISTORY AND IMPORTANCE

As the use of wood in forested countries led to the importance of carpenters in construction, so the great alluvial plains and the sparsely treed rocky hills of the Mediterranean regions forced man to make his habitation from dried or baked mud, in pieces of convenient sizes, or from the more easily worked rocks. Where fuel was scarce, and rainfall light, as in Egypt, sun-dried clay mixed with chopped straw sufficed to make bricks, as it does to this day for the adobe houses of similar American areas. Burnt brick was, however, used in Babylon. In wetter climates, the clay itself was pressed into shapes of even size, and baked to a hardness varying with its mineral content. This gave rise to a class of craftsmen, the bricklayers, skilled in the art of laying and bonding bricks. The use of stone blocks required a technique similar, in some respects, to that of the bricklayer. This helps to explain the grouping together of the brick and stone-masons in the census classification.

Romanesque architecture involved intricate design in brickwork. The large ecclesiastical, military and governmental structures of the middle ages required of both bricklayers and stone-masons additional knowledge, ability and art.

The Tudor and Jacobean periods in England produced the zenith of the bricklayer's artistic skill.

Since even wooden buildings, so numerous in North America, require brick chimneys and often stone or brick foundations, there is very little building construction in which bricklayers or stone-masons are not concerned.

Photo N.F.B.

Building a chimney

DUTIES

The United States Dictionary of Occupational Titles gives eleven types of bricklayer, with definitions varying according to the class of work done. A general definition by the Occupational Outlook Division of the U.S. Department of Labor covers all these, as follows:

"A skilled craftsman who lays brick, terra cotta and similar building blocks (except stone or marble) in the construction of brick walls; furnaces, chimneys, sewers, roads, tunnels, factories, and on repair work. He extends a gauge line which serves as a guide for laying brick in horizontal layers, continually checking with a level and plumb-bob to make sure the brick work is straight up and down as well as level. He cuts brick, shapes mortar in joints between the exposed faces of bricks, constructs over-hanging supports of brick, and fastens brick veneer to concrete and other rough surfaces. He may supervise an apprentice. He generally works from blueprints. He uses a bricklayer's hammer, chisel, trowel, jointer, square, gauge line, level, plumb-bob and rule. Metal anchoring devices may be among materials used."

A stone-mason's work is similar, but with different and larger material, and sometimes involves the direction of a crane conveying the stone to him.

A union constitution states:

"Fireproofing, block arching, terra cotta cutting and setting, the laying of plaster blocks, mineral wool blocks, cork blocks, or any building material composed of burnt clay; the cutting, rubbing and grinding of all kinds of brick, and the setting of all cut stone trimmings on brick buildings, is bricklayer's work". (Cutting, rubbing and grinding are methods used in the sculpture of bricks, an art practised by highly skilled men.)

QUALIFICATIONS

Normal apprenticeship age is 16 to 18.

The physical demands for bricklayers and stone-masons closely approximate those for carpenters. A special requirement is a colour sense for matching bricks, tiles, or stones in patterns, in accordance with the architect's design.

A rugged physique is necessary to perform heavy lifting and to cope with weather conditions encountered while at work. Since climbing, standing, walking, stooping, turning, kneeling, pulling, pushing and crouching may all be needed in working, and grasping, lifting, carrying, and the use of striking tools are involved, bricklayers and masons must be sound of limb.

These occupations are therefore unsuitable for those physically handicapped.

An education reaching at least to public school graduation, with added technical or high school courses covering mensuration, simple plane geometry and elementary physics, is most desirable for the entrant into these trades. He must have a real interest in mechanical operations, ability to learn the physical qualities and uses of all the varied materials used, to read and interpret blue-prints, to visualize the completed job from written or oral instructions, and to understand the work performed by other tradesmen engaged on the same project. A bricklayer or stone-mason must be able to co-operate with his fellow-workers.

He must be exceedingly accurate and painstaking. Speed is less a factor in these trades than reliability, since any error made or work "scamped" may affect the stability of the whole structure. Pride in good workmanship is a tradition in this craft; meticulous care is essential.

If his ambition is to become a contractor, he must learn how to make rapid computations, to deal with clients and labour in a business-like manner, to keep simple accounts, and to be thoroughly familiar with local building regulations.

TRAINING

As these are designated occupations in all provinces, except British Columbia and Prince Edward Island, formal apprenticeship of four years is almost everywhere compulsory before a journeyman's standing can be attained. In New Brunswick the period is 3 years for bricklaying, 4 years for stone-masonry.

Credit for technical or vocational courses on apprenticeship is assessed locally. In Alberta the apprenticeship period involves compulsory attendance at a school for apprentices for from one to three months in each year. Similar school provisions, with varying periods, exist in other provinces.

Training on-the-job while apprenticed is the only method of entering the stone-mason's trade.

The Montreal and the Chicoutimi Building Trades Apprenticeship Commissions give pre-apprenticeship half-year courses, credits to be determined upon completion.

Credits for trade experience in the armed forces are determined in each individual case, in most provinces.

ENTERING OCCUPATION

Apprenticeship to bricklaying is by arrangement with a master bricklayer, the local union, and the provincial Apprenticeship Board. The National Employment Service can be of assistance here.

The same is true of stone-mason's work, but there are so few skilled stone-masons that opportunities for apprenticeship are scarce, even in Eastern Ontario, where building stone has been used more than in most other regions. (The Ottawa area had in 1946 about 25 stone-masons only). In September, 1946 there were no stone-masons training in Quebec Province.

EARNINGS

Average wage rates per hour for journeymen in 1944 and 1948 were:

	Bricklayers (1944)	Stone-Masons (1944)	Bricklayers and Stone-Masons (1948)	
Maritimes	$1.10 (90¢ —$1.15)	$1.07	Halifax	$1.41
			Saint John	$1.45
Quebec	$1.05 (1.00— 1.10)	$1.04	Quebec	$1.20
			Montreal	$1.40
Ontario	$1.14 (1.00— 1.26)	$1.16	Toronto	$1.75
			London	$1.60
Prairies	$1.21 (1.05— 1.30)	No record	Winnipeg	$1.55
			Regina	$1.65
Pacific	$1.25 (1.15— 1.25)	No record	Edmonton	$1.75
			Vancouver	$1.75

In some areas vacation with pay is now given. Counsellors can ascertain local rates through union officials. Local agreements are the rule.

The contra-seasonal employment in 1948-49, and the extensive nature of the plans for construction of a type needing these trades, are likely to lead to a considerably longer work period and higher annual income in the immediate future.

Minimum apprentice rates recommended by the National Joint Conference of the Construction Industry, and adopted by Ontario are: 1st year, 30 per cent; 2nd year, 40 per cent; 3rd year, 50 per cent; 4th year, 70 per cent of the journeyman's rate. In some areas they are considerably higher at present, varying from 35-80 per cent in Alberta to 50-80 per cent in the Montreal area. In Saskatchewan the range is 56¢ per hour to $1.25. Increases are annual except in Nova Scotia, where they are semi-annual.

ADVANCEMENT

The line of advancement is from apprentice to journeyman, journeyman to foreman or sub-contractor, foreman to superintendent of construction or sub-contractor to contractor.

RELATED OCCUPATIONS

The whole brick, stone and tile-mason group, including terrazzo worker and tile setter, is inter-related, but there is no occupation outside of this group, except plasterer, which can be regarded as related. Stone-cutters do perform some tasks analogous to those of stone-masons, and so do sculptors. Part IV of the United States Dictionary of Occupational Titles lists, under 4-X6.231, 232, 233 and 244, subdivisions of all the "trowel trades groups".

ADVANTAGES AND DISADVANTAGES

The possibility of working up to one's own contracting business is a major advantage. The work is interesting, resulting in a visible achievement. In some phases it may be artistic. The close union control, and the general apprenticeship regulation, make for stability in the reasonably high hourly wage rates. Because of the nature of the work the bricklayer or stone-mason is not harassed by semi-skilled competition. Most of the work is outdoors. These trades share in the benefits of Unemployment Insurance and Workmen's Compensation.

The work is, however, of a dusty nature, and may be very hard on the hands, even when gloves are worn. There are the risks attendant on work at heights on scaffolds, the use of ladders, or exposure to inclement weather. The high percentage of bricklayers in the older age groups previously mentioned may, however, be considered in this connection.

The seasonal character of this employment, though greatly modified by modern practice, has in the past been its greatest disadvantage, and one which was aggravated in "depression" periods, when these trades were in even less demand than those of the carpenter, painter, and plasterer. The existing back-log of construction (1948) seems likely to take care of employment for several years to come.

ORGANIZATIONS

Most bricklayers and stone-masons are members of craft unions, long-established.

Photo N.F.B.

Preparing material for the bricklayer

TRENDS

Number and Distribution

The 1941 census records 8,948 in "brick and stone-mason occupations". The National Joint Conference of the Construction Industry, 1946, reported a total of 4,273 journeymen bricklayers. Figures were not given for stone-masons, but if the seven to one proportion of bricklayers to stone-masons which appears to obtain in the Ottawa district holds generally, which may not be the case, there should be about 620 of these in addition to the 4,273 bricklayers. A recent newspaper report, giving 100 as the total of stone-masons, is perhaps an under-

estimate. Thus, 4,900 would represent the fully-skilled employed craftsmen in these trades in the construction industry. As indicated below, there were 741 in "Manufacturing"; these and the 177 in "Other Industries" would be employees also. Adding all of these to the 1,450 employers and "own accounts" makes a total of 7,268, leaving 1,680 as the difference between this figure and the 8,948 recorded in the census, which difference probably represents the "helpers" and apprentices. On the basis of a ratio of one apprentice to eight journeymen, it is not likely that in 1946 there were more than 600 bricklayer and stone-mason apprentices in the construction industry.

Numerical Proportion to Construction Occupations

Bricklayers and stone-masons formed only 4.3 per cent of all the employed construction workers enumerated by the National Joint Conference of the Construction Industry in 1946. Plasterers were 3.7 per cent. These two groups were numerically small compared with carpenters, who made up 55 per cent, painters 17 per cent and plumbers 10 per cent.

Age Distribution

There is an exceptionally high proportion of workers in the bricklayer and stone-mason trades who are in the upper age groups.

Of the 9,448 bricklayers and stone-masons recorded in the 1941 census, no fewer than 3,238, or over 34 per cent, were in the age groups from 55 up. Excluding those who were on active service, the percentage is slightly over 36. This compares with 25.5 per cent for the construction industry generally, 30.3 per cent for carpenters, 10 per cent for electricians, and 18.1 per cent for all non-agricultural occupations. This shows to some degree the effects of the lapse in immigration of skilled tradesmen, and the lag in apprenticeship during the depression years.

Regional Distribution

The association of these trades with urbanized and industrial areas, and their scarcity in largely agricultural ones, will be seen by a comparison of the figures quoted below, for Ontario and Quebec, with those of the Prairie Region, where wooden construction is general outside of the cities and larger towns. The eight largest cities, having 23 per cent of the population of Canada, had 39 per cent of all bricklayers. Available building materials, and the period and nature of the original settlement, have also a marked influence, as is shown by a comparison of Ottawa, with almost a 1 to 6 proportion of brick and stone-masons to carpenters, and Vancouver with a ratio of about 1 to 16.

Ontario and Quebec, with about 62 per cent of the population, support almost 80 per cent of the men in these trades.

	PERCENTAGE OF TOTAL FOR CANADA				
	Maritimes	Quebec	Ontario	Prairies	Pacific
Brick and Stone-masons (1941)......	8.5	32.6	46.0	7.6	5.3
Population (1941).....	9.7	29.1	33.0	21.0	7.2

Employment by Industries

Of the total number of bricklayers and stone-masons, the great majority, 8,030, were employed in the construction industry. Manufacturing engaged 756; other industries employed 162. The proportion of these tradesmen in industries other than construction was smaller in 1941 than in 1931.

Decline in Numbers

In the 1921-31 period there was actually an expansion in the brick and stone-mason trades, (19.0 per cent), almost corresponding to that of population (18 per cent). The 1931-41 falling-off of 18 per cent can be related directly to the effect of economic conditions in the 1930's on industrial construction of a permanent type, and to the

temporary character of much of the wartime construction at the time of the 1941 census, which required little of the brick and stone-mason's skill.

Technological changes such as the increased use of poured concrete to replace brick and stone foundations, and of pre-fabricated building, have probably contributed to a lessened employment of bricklayers and stone-masons, and to lack of interest in these trades among potential apprentices. New materials such as cement and glass blocks and hollow wall tile, however, now require the bricklayer's skill.

These are "designated" trades for apprenticeship in most provinces, and growth will thus be a regulated one, since the unions maintain a ratio of apprentices to journeymen in normal times.

Unemployment in these trades was formerly linked with weather conditions. The shorter the season in which outdoor construction can be carried on, and mortar can be set, the more limited is the working period of bricklayers and stone-masons. The urgency of much post-war construction had led to a change in established methods, and a contra-seasonal use of bricklayers is, as indicated in the "Demand and Supply" section of this monograph, actually taking place.

It is expected that this change will be carried into regular practice in normal times. Some 1948 advertisements offered full-time employment for the whole winter.

Working Proprietors

The 1941 census records 1,457 as employers and "own account" workers in these trades, or 15.4 per cent of all. This compares with 12,920 carpenters or 13.6 per cent, and 17 per cent in all construction trades.

Present Demand and Supply

Reports indicate that there is an acute shortage of bricklayers and stone-masons in the country as a whole, and especially in the central provinces.

At the end of February, 1948, at a time of year when construction is normally at a seasonal low point, the National Employment Service record showed registered vacancies and applicants as follows:

BRICKLAYERS AND TILE-SETTERS

	Canada	Maritimes	Quebec	Ontario	Prairies	Pacific
Vacancies....	288	7	44	208	20	9
Applicants...	572	119	221	130	63	39

The corresponding figures for September 30th, 1948 are:

	Canada	Maritimes	Quebec	Ontario	Prairies	Pacific
Vacancies....	481	58	130	225	62	6
Applicants...	71	17	24	13	5	12

The full situation is obscured by the fact that an appreciable percentage of placement in construction trades is done through the unions.

The National Joint Conference of the Construction Industry estimated in February, 1946, that the requirements of the construction industry alone, for carrying out the programme immediately ahead, were 5,873 bricklaying journeymen, and that 4,273 were available, making a shortage of 1,600. Its estimate of apprenticeship requirements for the four years to follow was 738, or 185 a year, distributed as follows in percentages by provinces: P.E.I. 0.2; N.S. 10.0; N.B. 3.3; Que. 36.0; Ont. 31.5; Man. 3.7; Sask. 2.3; Alta. 4.6; B.C. 8.4. This estimate does not allow for the approximately 2,000 brick and stone-masons not engaged in the construction industry proper.

In December, 1946 there were 1,427 veterans trained or in training for these occupations. Most of these are reaching, or have reached, journeymen status, and the trade must depend on youth for its recruits.

A statistical computation for normal times, based on a 35-year working life, a mortality of 8 per thousand, and an increase of 1 per cent in population, suggests that an annual intake of nearly 450, or 5 per cent, would cover necessary recruiting.

The very considerable number in these trades in the 55-and-over age groups in 1941, however, indicates an increase of possibly 25 per cent in retirements over and above the normal 35-year working life basis. Thus the 450 calculated in the preceding paragraph would be increased to approximately 550.

This calculation cannot be said to be valid at present, but may well be applicable if and when construction settles into a more or less stable course.

Qualifying Factors

Brick and stone construction has formerly been limited in Canada by the short season governing both the preparation and the use of the material. The Department of Reconstruction and Supply estimated in 1946 that only 8 per cent of new housing would be constructed of solid masonry, 7 per cent of solid brick, 6 per cent concrete masonry blocks and stucco, and 20 per cent of brick veneer. ("Manpower and Material Requirements for a Housing Programme in Canada", 1946). The proportion of solid brick masonry or block construction in industrial and public buildings, and in those required by trade and commerce, would be very much greater, and there appears to be no great delay in carrying out the programme in this type of construction, mostly in urban areas.

Care must be taken, in considering the prospects for employment in the brick and stone-mason trades in any area, large or small, to ascertain the type of construction, and to avoid correlating these trades with housing projects in particular and building permit totals in general. At the same time, the current activity in the larger and more permanent types of construction may be regarded as employing a greater number of bricklayers and masons than may be needed when present undertakings and plans are completed, as these represent an abnormal demand.

Domestic construction has been slowed up by material, site, and labour costs. Industrial, commercial and institutional construction has been less hampered by these

factors; this may account for a relatively high current demand for bricklayers, as compared with that for carpenters.

The use of pre-fabricated walls, of poured concrete to replace brick and stone, and the application of stone in decorative slabs rather than in solid blocks, will tend to reduce the demand for labour in the two crafts, unless found less economic than older methods and the use of other new materials requiring bricklayers.

There can be little change in methods of working; owing to the time element in the setting of mortar, only a limited number of courses can be laid in a day. As a result, "efficiency" schemes involving assembly-line methods are not practicable, except possibly on large jobs.

Immigration might affect these crafts by bringing in trained workers, but the construction needs of Europe seem to minimize this. An increase of population, of course, would increase the housing demands.

A continuance of the recent trend towards urbanization would undoubtedly provide corresponding demand for brick and stone-masons in greater proportion than would expansion of rural or semi-rural population.

Conclusion

There is an excellent prospect for employment, subject to weather and seasonal inclemencies, of all available bricklayers and masons for the next three or four years, at least.

The high percentage in the older age groups, and the present shortage of craftsmen, would seem to indicate a continuity of employment for qualified men even when conditions in the construction trades settle to a normal course. Apprentices are badly needed (1948).

It will hardly be possible to eliminate entirely the seasonal character of these trades, but modern planning of construction will protract the season to an appreciable extent. Cover and heat are provided by up-to-date contractors when needed.

REFERENCES

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AUDIO-VISUAL MATERIAL

Readers desiring information on film sources, available material, and the organization of local film libraries may obtain it from the National Film Board offices, as listed in Monograph I.

DEPARTMENT OF LABOUR

Economics and Research Branch

OTTAWA, 1949

OTTAWA
EDMOND CLOUTIER, C.M.G., B.A., L.PH.,
KING'S PRINTER AND CONTROLLER OF STATIONERY,
1949

CANADIAN OCCUPATIONS

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PAINTER

(Construction and Maintenance)

★

MONOGRAPH 4

DEPARTMENT OF LABOUR, OTTAWA

CANADIAN OCCUPATIONS

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MONOGRAPH 4

HON. HUMPHREY MITCHELL, MINISTER
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The monographs have been prepared by our research staff working on occupations, with the generous help and advice of officials of the Unemployment Insurance Commission, Vocational Training Branch and Bureau of Technical Personnel of the Department of Labour, Dominion Bureau of Statistics, Provincial Departments of Education and of Labour, employers' associations, trade unions, professional associations, and other government and non-government bodies.

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DIRECTOR,
Economics and Research Branch,
Department of Labour.

March, 1949.

PAINTER

HISTORY AND IMPORTANCE

The application of pigments to exterior and interior surfaces, particularly those of wood, has served to decorate and preserve the dwellings of man since very early times.

In Canada, where the use of wood in construction has always been very extensive, and where extremes of heat and cold must be borne by buildings, the work of the construction and maintenance painter is a basic necessity to an extent greater than that in more equable climates. A house whose exterior trim and sashes are not repainted in time will quickly deteriorate, and a year or two of neglect in this respect may involve replacement of much expensive woodwork. Interiors, too, suffer both in appearance and in actual material if paint and varnish are not renewed at the proper time. New structures must be protected at once. Metal requires protection similar to that given wood.

This protective and decorative work is not simply a matter of using a ready-mixed paint and a cheap brush. The pigment must be correctly mixed with medium and thinner, both in content and colour, and the preparation of the surface, the application of the several coats, the uniformity of the mixture, the use of the proper type of brush for each part of the work, the avoidance of intrusion on areas not to be painted—all these are dependent on the knowledge and skill of the craftsman who does the work. Most of us can distinguish a "good paint job" from a poor or bad one.

The craft has long been organized in the older lands; the hall of the Painters' Company in the City of London has long served as a wonderful example of 17th century woodwork, testifying to the importance, artistic taste, and prosperity of the trade in that era. The trade has always preserved high standards of reliability and efficiency, and these traditions are carried on by its organized bodies in North America.

This monograph deals only with those painters engaged in building construction and maintenance. The large number of persons engaged in routine painting work, often requiring a minimum of skill, in manufacturing, are frequently associated with the labour organization of the industry they work for rather than with the painter's craft union, nor are portrait, landscape, genre or other artists included here. The United States Dictionary of Occupational Titles gives over 90 classes of painter; of these, three only are herein considered, performing duties as outlined below.

Photo: N.F.B.

DUTIES

The general classification in the Dictionary of Occupational Titles "Painter I" applies to all three. It is defined as follows:

"Performs all classes of painting work, such as painting interior of houses, sheds and other structures (Painter, rough), and painting and decorating the interior of buildings (Grainer, hand; Painter, interior finish); mixes paint and matches colours by stirring together the proper proportion of pigment, base, and thinner; uses brushes or spray gun to apply paint; erects working scaffold; removes old paint by applying liquid paint remover or by heating surface with blowtorch and scraping off paint."

A "Painter, maintenance" paints and redecorates walls, woodwork and fixtures, removing old paint, fills nail holes and interstices with filler or putty, and mixes and applies paint.

Stains, varnishes and shellac are implied in the expression "paint" in these definitions, as well as the material properly so called.

QUALIFICATIONS

As in all skilled trades, the would-be apprentice should have an education above the elementary level, and would be wise to prolong this as far as possible, and to include any available technical courses closely related to the occupation. Since many painters operate on their own account, arithmetic and bookkeeping should be given special attention.

While painting does not involve much handling of heavy materials, it requires a physique capable of long work in a standing position, an ability to work in high places, strong wrists, and a steady hand. A good eye for colour and for surfaces, and ability to study harmonies and to match shades, a general knowledge of the duties of other construction crafts in their relation to his own activities, are all required of a construction painter. If

he studies the physical and chemical qualities of pigments, varnishes and media, he is likely to find his work giving increased satisfaction.

Basic personal qualities required are tact, courtesy, and tidiness, since work will often be done in inhabited homes.

TRAINING

This is a trade designated for apprenticeship in all Canadian provinces, except Prince Edward Island.

Local regulations should be consulted. The duration of the course is four years. In some cases an allowance may be made in time for technical training, such as that which was received in Canadian Vocational Training schools or that of the Montreal Building Trades Apprenticeship Commission.

In most provinces a proportion of the apprenticeship time is devoted to class instruction.

ENTRY INTO OCCUPATION

The number of apprentices is naturally related to that of journeymen, and aspirants for entry should apply to the Youth Section of the National Employment Service for information as to the local situation with regard to placement opportunities.

There is no occupation which can be regarded as an "entry" one to this trade. Apprenticeship is the rule.

EARNINGS

The following are some hourly rates for journeymen as of February, 1949:

	$		$
Charlottetown	.80	London	.90
Saint John	.96	Fort William	.95
Halifax	1.07	Winnipeg	1.15
Quebec	.95	Regina	1.10
Montreal	1.15	Saskatoon	1.00
Ottawa	1.10	Calgary	1.25
Toronto	1.25	Edmonton	1.25
Hamilton	1.10	Vancouver	1.35

Apprentice rates are based on a percentage of these, usually 30 per cent in the first year, rising on an annual scale up to 70 per cent or 80 per cent in the last year.

Master painters usually make enough to maintain a reasonably good standard of living. Some combine paper-hanging or a retail paint store with their regular trade. The capital involved is not, as a rule, large at first.

The work week varies locally, and in accordance with the nature of the job and the season. An average would probably be 44 hours.

ADVANCEMENT

The apprentice receives an increase in wages each year, and on completion of apprenticeship and the passing of a trade test is classed as a journeyman. Advancement from journeyman is to foreman, or to contracting on own account as a master painter.

RELATED OCCUPATIONS

Painter, boat, finish; painter, automobile; painter, car, locomotive and car building and repair; painter, furniture; painter, frame, and painter, sign, all perform duties closely related to and requiring similar skills and knowledge of those of painter, construction and maintenance. A small group of hand painters in furniture, picture frame and pottery manufacture are highly skilled.

On a lower level of skill are most of those employed in spray or mechanical painting, or in assembly line work by hand, in industrial production. Their work is chiefly of a routine nature, requiring little or no skill.

The professional group includes portrait, landscape, mural, genre, miniature and other highly skilled artists. It employs to some extent the same materials and tools as does the skilled construction painter, and, in the case of mural painters, may actually work on interior surfaces of buildings. The difference is one of individually specialized ability, taste, training, knowledge, observation, and imagination. Certain construction painters of unusual skill do work in decoration approaching that of the professional group.

ADVANTAGES AND DISADVANTAGES

A major advantage in this trade is the satisfaction of a good job done, remaining to be seen in concrete form. The work is much less monotonous than may at first appear: skill and intelligence are being employed, and there is ample scope for study and the acquisition of new techniques.

Earnings are at an hourly rate and compare favourably with those of most skilled trades. Workers in this trade share in the benefits under Unemployment Insurance and Workmen's Compensation legislation.

Union regulations and provincial legislation protect the painter from unskilled and semi-skilled competition.

Work may be outdoors or indoors.

The cost of the working kit is not great, and it is possible to set up on one's own account with small capital.

Outside of the seasonal slack time, the hazards common to all occupations using ladders and scaffolding, and those incident to construction work generally, and the necessity of much standing and some stooping or recumbent work, there are no marked disadvantages in this trade. Care must be taken to avoid dangers to health inherent in the handling and use of the paints and varnishes.

ORGANIZATIONS

Painters in construction are usually members of craft unions. In other industries they may belong to industrial unions.

TRENDS[1]

Number in Occupation

In 1941 there were just over 40,000 painters and glaziers listed in the census. Of these some 28,000 were engaged in construction work. In 1931 the respective figures were

[1] For information on trends in the construction industry, the reader is referred to Part I of Monograph I, "Carpenter".

35,000 and 25,500. In 1921, painters in all industries numbered 23,500. Since glaziers, and painters doing routine factory work, are included, the comparable figures for the decade 1931-41 for skilled painters alone are probably:

1931	23,500
1941	25,500 (an increase of about 9 per cent).

This increase is slightly below that of the population as a whole for the same period (about 11 per cent), and compares with one of almost 16 per cent for the whole census group (from 34,827 to 40,337) of miscellaneous painters and glaziers.

The slack period of construction in the 1930's did not encourage recruitment, and indeed employment in this trade had dropped, just before the war, to about 60 per cent of the 1926 level, while houses all over the country gave mute evidence of the real need for painters. Since the end of the war, efforts to increase the personnel of the construction trades resulted in the entry of many veterans; Canadian Vocational Training, between April 1944 and November 1947, had enrolled 884 in painting courses, and between these dates close to 600 veterans had entered the trade. These would be an important percentage of total entrants.

In February 1946 it was estimated by the National Joint Conference of the Construction Industry that painters made up 17.3 per cent of all construction tradesmen.

The Conference estimated that the actual number of painters in the construction industry at the time was about 16,000, presumably excluding maintenance painters.

A survey made in the summer and fall of 1946 by the Department of Veterans Affairs gave a total for painters, decorators and glaziers of 41,000, and estimated annual intake of 2,650. This was a period of considerable labour turnover in factory work, and the figures indicate that there had been only a slight increase over the 1941 figure of 40,000 for the whole group.

AGE GROUPS

At the time of the 1941 census, the whole painter group included 20 per cent over 60 years of age, and 20 per cent between 50 and 60. The annual mortality in these groups would normally total over 600, and retirements are likely to be heavy following the strenuous post-war construction period. These men are now 8 years older, and it is certain that few young men entered the skilled trade in the war years. Thus it would be reasonable to expect a need for replacements for those dying or retiring to reach at least 1,200 annually. The veterans entering the trade will mostly be in the twenties now.

DISTRIBUTION BY INDUSTRY

The 1941 census showed the following distribution of all painters, decorators and glaziers:

		Men	Women
Primary Industry		129	
Manufacturing:			
Automobile and auto-repairs	1,177		
Railway rolling stock	668		
Shipbuilding	394		
Paints, varnishes	228		
All others	6,110	8,577	235
Construction		28,277	55
Transportation and Communication		635	
Trade and Commerce		584	
Finance and Insurance		32	
Service		711	
Not Stated		113	
		39,058	290

The majority of those under "manufacturing" would not have been skilled tradesmen. The railway, ship, and paints and varnishes groups probably had a large skilled percentage. Maintenance painters are likely to have been strongly represented in the transportation, finance, trade and commerce, and service industry groups.

REGIONAL DISTRIBUTION

According to figures obtained in the D.V.A. survey in 1946, the following was the distribution of the whole painter group, approximately:

Maritimes	7.2%	Ontario	42.3%
Quebec	33.9%	Prairies	8.4%
		British Columbia	8.2%

There is some indication that urbanization creates a greater demand for painters; in the absence of detailed figures as to the proportion of skilled tradesmen included it is, however, reasonable to suppose that the groups of semi-skilled painters in industry have weighted the proportions for the industrialized provinces to some extent. The localized nature of residential construction projects has probably complicated the distribution of painters since 1946.

PRESENT LABOUR DEMAND AND SUPPLY

The seasonal nature of this occupation, even with increasing employment resulting from improving construction planning, is indicated by the following National Employment Service figures reported in 1948, for all offices throughout Canada:

	Unfilled Vacancies	Unplaced Applicants
August	235	551
October	150	1,255
November	72	2,327
December	30	3,863

The figures here cover all groups of painters. It should be remembered that placements are also made directly by employers, but the figures above are no doubt indicative of the seasonal changes in employment.

In the busy season, supply and demand are almost equated. There are no marked divergences between regions.

FUTURE EMPLOYMENT PROSPECTS

The prospects of construction painting during the coming years are naturally largely dependent on the extent of housing construction. There is no sign of slack-

ening as yet in industrial and public construction plans, but the painting costs of these may be likely to constitute a smaller proportion of the total cost than in the case of domestic building.

There is still, however, a very large back-log of neglected painting waiting to be done on existing buildings in most areas, both urban and rural.

The data given above on replacement needs and veteran trainees do not lead to the belief that total accessions to the trade since 1945 have been such as to cause any overcrowding. The National Joint Conference of the Construction Industry estimated that at least 3,000 new entrants would be needed in the years 1946-49 inclusive; and estimated also an existing shortage of 6,500 in the trade.

There is little to be gained in attempting to establish any firm basis for future demand, in view of the variable factors outlined in Part I of Monograph 1, affecting all the construction trades.

One factor of special interest to this trade is the tendency of some owners of rented property to put off repairs, in view of high costs. The excess demand for accommodation of any kind, over recent years, has tended to create an abnormal back-log of repainting. The same is true of many owner-occupiers, awaiting lower costs.

REFERENCES

Department of Education, Victoria, B.C., "B.C. Occupations Series", *Painter,* 1947.

Dept. of Education, Province of British Columbia, *Analysis of the Painting Craft for Apprenticeship Training, 1946.* (This gives details of a course in painting and paper-hanging).

AUDIO-VISUAL MATERIAL

Readers desiring information on film sources, available material, and the organization of local film libraries may obtain it from the National Film Board offices, as listed in Monograph I.

DEPARTMENT OF LABOUR

Economics and Research Branch

OTTAWA, 1949

OTTAWA
EDMOND CLOUTIER, C.M.G., B.A., L.PH.,
KING'S PRINTER AND CONTROLLER OF STATIONERY,
1949

CANADIAN OCCUPATIONS

★

PLASTERER

★

MONOGRAPH 3

DEPARTMENT OF LABOUR, OTTAWA

CANADIAN OCCUPATIONS

★

PLASTERER

MONOGRAPH 3

HON. HUMPHREY MITCHELL, MINISTER
ARTHUR MACNAMARA, C.M.G., LL.D., DEPUTY MINISTER

DEPARTMENT OF LABOUR, OTTAWA

FOREWORD

During recent years there has been a steadily increasing demand for up-to-date information on occupations.

This demand comes from youth faced with the need of choosing an occupation and of selecting the type of training required; from parents, teachers and other counsellors; from workers shifting to other occupations; from employment service officers; from directors of personnel and union officials, and from other quarters.

This series of monographs and an accompanying series of pamphlets, the latter containing similar information in a condensed form, are attempts to meet this demand.

These publications represent an expansion of an earlier series issued by the Department of Veterans Affairs to assist members of the armed forces returning to civilian life following the end of the war. These current series, designed for general use, cover a wide range of occupations, including professions. They indicate, among other things, the nature of the occupation or group of occupations, entrance and training requirements, working conditions and opportunities in each.

The monographs have been prepared by our research staff working on occupations, with the generous help and advice of officials of the Unemployment Insurance Commission, Vocational Training Branch and Bureau of Technical Personnel of the Department of Labour, Dominion Bureau of Statistics, Provincial Departments of Education and of Labour, employers' associations, trade unions, professional associations, and other government and non-government bodies.

Grateful acknowledgment is made of this assistance and that obtained from numerous publications on occupations prepared in Canada and in other countries.

DIRECTOR,
Economics and Research Branch,
Department of Labour.

March, 1949.

PLASTERER

HISTORY AND IMPORTANCE

The irregularity of interior surfaces of primitive reed, wattle, wooden, brick and stone buildings led, as civilization advanced, to the desire for a smooth and regular covering which would weatherproof the walls and lend itself to decorative purposes. The use of lime and gypsum for these purposes dates back to early Egyptian dynasties, at least 4,000 years ago. Mud was probably used, in imitation of beavers and some birds, for interior facing of reed or wattle walls in a much earlier period. In the heyday of Greek civilization, plaster was used for statuary and for ornamental work of a high degree of artistic attainment. Rome employed plaster as a base for wall paintings, some of which can still be seen. Much famous Italian mural art is painted on fresh plaster ("fresco").

In England, the wattle houses used by the poorer classes were plastered inside and out; outside walls of lath and plaster can still be seen in poorer sections of Canadian towns and cities, and cottages of wattle and plaster construction, several centuries old, still survive in rural England. The plaster combined fire and weatherproofing.

The Renaissance period introduced fine decorative plaster art into domestic architecture in Western Europe, and quite elaborate plaster mouldings were common in houses built up to about 1910. Since that time, the use of plastering has been more generally utilitarian, but fine work in panelling, pilasters, etc., is being revived. Ornamental stucco facades were popular in the 18th century, but the use of stucco on exteriors is now, though increasingly extensive, quite plain in character.

DUTIES

A plasterer applies plaster to walls and ceilings, spreads it over wooden, metal or gypsum laths with a trowel. Wooden lath is not much used on new construction. He smooths the surface by rubbing with a "darby" over the

Photo N.F.B.

An apprentice at work

plaster; may coat the back surface of pre-cast ornamental plaster with plaster mortar, and stick or set it by pressing into the wall or ceiling. May do "three-coat" work, usually on flat surfaces; the first coat contains hair and is scratched and roughly smoothed; the second coat, which contains no hair is put on and "floated"; the third coat of lime and plaster of Paris is very thin and smooth; (a putty coat for imitation tile finish is also used). He may

do maintenance work in an establishment, or may specialize in rough-coat work.

A plasterer (moulding) moulds, casts, and installs ornamental plaster panels and trim. He moulds from a template, and cuts trim to size when hardened. He then applies a coat of plaster to the wall, and presses trim into position. In casting cornices and mouldings he nails guide strips to the wall, applies plaster with trowel, pushes template over plaster, removing excess plaster, until desired shape and smoothness is obtained. This work demands the highest skill, and is usually specialized.

A stucco "mason" or plasterer applies a weatherproof, decorative covering of portland cement or gypsum plaster to outside surfaces, erects scaffolds, applies coats with a trowel, using plasterer's technique. The final coat is decorated with sand markings, with a brush, or with a trowel, by spattering with small stones, or by "sgraffito" (scratching). This is usually a specialized job with plasterers.

QUALIFICATIONS

Age limits for apprenticeship include a minimum of 16 (in British Columbia 15), and a maximum (with exceptions) in Ontario, Manitoba, and Alberta of 21, in Quebec of 25, and in other provinces, open.

Educational qualifications at least up to public school graduation, with preferably some secondary or technical school training, are desirable. Alberta and Manitoba require Grade IX standing for apprenticeship, Ontario and New Brunswick, Grade VIII; other provinces do not specify standards.

Accuracy, speed (since material sets quickly), dexterity, adaptability, neatness, ability to co-operate with other tradesmen, and knowledge of their procedure, are necessary. A reasonably strong physique, with no physical handicaps, is required for this trade.

Plasterers must be able to supervise the proper mixing and sometimes colouring of the materials they use, and to direct labourers and apprentices. They must be pre-

pared to erect or supervise the erection of scaffolding suitable for each job undertaken.

Since the proportion working on "own account" is high, plasterers need ability to estimate costs and prepare tenders, to work from verbal or written instructions or from plans, to advise on suitable wall finishes, and to keep elementary accounts. They must be prepared to master local building regulations and be governed by them.

TRAINING

Apprenticeship is for four years, except in New Brunswick and Saskatchewan, which require three years and "4,000 hours to three years", respectively; regulated by provincial authorities and by the unions locally. A common syllabus of training is being prepared by representatives of provincial Apprenticeship Boards for submission to all the provinces. Prince Edward Island has not yet implemented its permissive legislation on this trade.

In Quebec the Building Trades Apprenticeship Commission gives accelerated training at its Apprenticeship Centres.

In most provinces school training is combined with apprenticeship for a set period in each year; in some cases correspondence courses for rural apprentices take the place of day or evening classes.

ENTERING OCCUPATION

Inasmuch as the number of apprentices in relation to journeymen is a matter of interest to the unions, as well as to the employer, enquiry should first be made of the local union branch, and arrangements made in accordance with advice by the responsible official. Provincial Apprenticeship Boards, on which both unions and employers are represented, set the ratio of apprentices to journeymen after consultation with the appropriate trade committee. Existing conditions have probably caused less rigidity in this respect than formerly existed. The National Employment Service, with its offices across Canada, can assist in making contacts.

With the exception of Quebec and British Columbia, a three months' probationary period is specified in the provinces designating this trade for apprenticeship.

EARNINGS

There is some variation, regionally, in standard hourly rates, which are locally arranged between the industry and the unions. The following are some representative 1948 hourly wage rates:

	Nov. 1948 $		Nov. 1948 $
Charlottetown	1.15	London	1.50
Halifax	1.32	Windsor	1.55
Moncton	1.20	Fort William	1.45
Saint John, N.B.	1.35	Winnipeg	1.45
Quebec	1.20	Regina	1.60
Montreal	1.40	Calgary	1.40
Ottawa	1.50	Edmonton	1.60
Toronto	1.80	Vancouver	1.75
Hamilton	1.50	Victoria	1.47½

Apprentice rates recommended by the National Joint Conference of the Construction Industry[1] in 1946 were, in the first, second, third and fourth year respectively, 30, 40, 50 and 70 per cent of journeyman's rates. These have not been generally adopted outside of Ontario. However, in local areas where demand is high, they have been exceeded. Saskatchewan starts apprentices at 55 per cent, and in five semi-annual increases they reach 90 per cent of journeyman's rates. British Columbia and Nova Scotia provide for semi-annual increases; the remaining provinces make them annual.

An extension of the working season, through recently introduced improvements on the traditional planning of building procedure, is in progress, and will materially improve earnings on an annual basis.

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[1] See Monograph I, "Carpenter", Page 8.

ADVANCEMENT

The general line of advancement is from apprentice to journeyman, journeyman to sub-contractor or foreman, sub-contractor to contractor. The greater opportunities are afforded by "own account" operations.

RELATED OCCUPATIONS

Plastering is a trade rather circumscribed in its relationship to other crafts.

Cement finishers perform work and use tools closely related to those of plasterers. Plaster moulders use similar materials, but a widely differing technique.

All brick and stone-mason (including terrazzo workers) trades are akin to plastering, the whole group being known as "the trowel trades".

ADVANTAGES AND DISADVANTAGES

Plastering, in common with all skilled trades, gives the satisfaction of visible achievement. In its more ornamental branch, the work approaches that of the artist.

The opportunity of establishing a personally-conducted business with small capital is reasonably good, since at least one plasterer in four is on his own account. Work is mainly indoors, with good lighting.

This trade shares in the benefits of Unemployment Insurance and Workmen's Compensation.

The competition of new ready-finished wall materials may affect demand for the plasterer's skill.

Occupational hazards are those inherent on work on scaffolds and ladders; the working position in ceiling jobs is a cramped one. The handling of cement, lime and plaster during mixing may involve the breathing in of fine mineral dust; work is also necessarily in damp conditions. Indoor work may be an objection, but there is outdoor stucco work also.

ORGANIZATIONS

Plasterers are well organized in various trade unions.

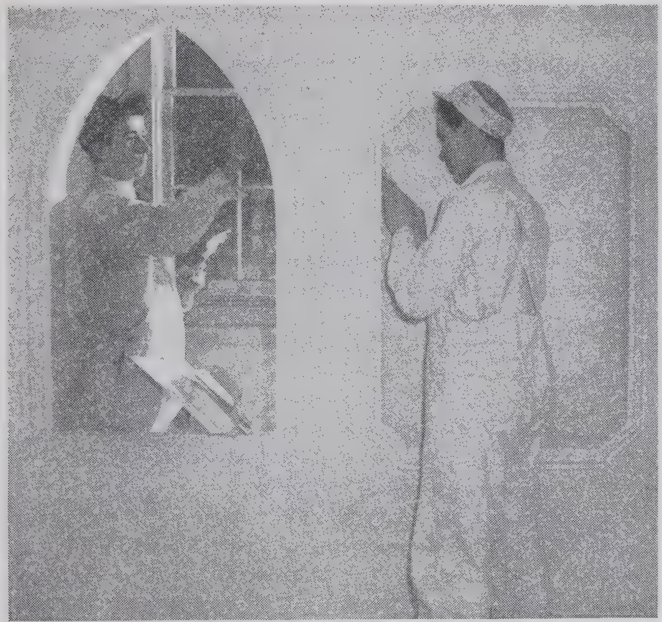

Photo N.F.B.

Fine work (panels and mouldings)

TRENDS[1]

Number of Plasterers

Plasterers make up a very small proportion of construction workers. The 1941 Census records only 5,003 "plasterers and lathers", including 334 on active service; the National Joint Conference of the Construction Industry in 1946 estimated 3,749 plasterers. This compares with a census record of 90,470 carpenters, 39,058 painters, and 8,948 brick and stone-masons. The usual proportion of lathers to plasterers was 1 : 2 or less. Technological changes may cause a progressive reduction in the number of lathers.

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[1] For information on trends in the construction industry as a whole, reference should be made to Part I of Monograph I, "Carpenter".

Age Distribution

This trade has a more than average percentage in the upper-age groups, in common with most of the skilled construction trades. Of the 4,669 civilian plasterers and lathers listed by the census, 1,266, or over 27 per cent were aged 55 and upwards, and another 1,095 were in the 45-54 age group. Since the average for the 55-and-over age brackets in all occupations is about 18 per cent, the effects of "depression" slackening of construction, and of inadequate apprentice recruiting, are clearly seen in this trade.

Regional Distribution

Plastering is to a considerable extent an urban occupation. The census lists only 17 in Prince Edward Island and 25 in New Brunswick. Of the 114 in Nova Scotia, 25 were in Halifax; of 1,470 in Quebec, 948 were in Montreal alone; Toronto had 504 of the 1,859 in Ontario, Winnipeg 179 of the 317 in Manitoba, Regina 38 of the 173 in Saskatchewan, Edmonton and Calgary 187 of the 346 in Alberta, and Vancouver 336 of the 682 in British Columbia.

The use of interior wallboard in rural districts and elsewhere, and the limitation of the exterior stucco work to a great extent to towns and cities, has some bearing on this distribution. The larger proportion to population in British Columbia may be accounted for by the attraction of the climatic conditions for Old-Country trained men, and the concentration of much of the population in cities and small towns.

Industrial Distribution

Distribution by industry is in this case limited. 98.2 per cent of all plasterers were engaged in construction work in 1941, nearly all the remainder being classified under "Manufacturing".

Working Proprietors

A comparatively large proportion of those in this trade operate as working proprietors. The 1941 census classified 125 as employers and 1,088 as "own account". These total almost 25 per cent of all in the trade.

Growth and Decline in Numbers

The influence of economic conditions is clearly seen in the record of numbers in this occupation in the two decades 1921-31 and 1931-41. The number of plasterers and lathers rose from about 3,200 in 1921 to about 6,200 in 1931, an increase of over 94 per cent, not related to population, which grew only 18 per cent. The industrial stagnation of the 1930's is clearly reflected in a drop in numbers to 4,875 by 1941, or a loss of 21 per cent against a population increase of 11 per cent. The net gain over the 20-year period was 1,676, or 52.4 per cent; this long-term increase, if related to the population increase, might well lead to misleading conclusions. It appears that the high level of construction activity in the late 1920's led too many people to enter this trade, and that deaths, retirements, and transfers to other work through unemployment reduced the numbers during the 1930's. Though the figures quoted above include lathers, the proportion of these to plasterers would hardly vary, the work being complementary. The net increase over the two decades may to some extent be associated with the fashion for exterior stucco construction which followed World War I.

Regularity of Employment

The seasonal nature of this work, and its dependence on the prior completion of the main structural features of a building, have resulted in past years in a short working period.

There are definite indications of extension of the employment period resulting from better planning in the post-war years; it is expected that this will become customary.

Since much of the construction in 1940-41 (the census was taken in June 1941) was of a temporary nature for wartime purposes, wallboard was very extensively used for interiors, and there was little or no plastering. Examples are the temporary buildings housing government offices, and those erected in camps and training centres.

As large-scale domestic construction gets under way, there probably will be a considerable proportion of interior and exterior work for plasterers, and wise planning of operations may provide for almost continuous work.

Present Demand and Supply

The present employment outlook for plasterers is very favourable. On 30th September, 1948, the National Employment Service reported 231 unfilled vacancies and 22 unplaced applicants, demand exceeding supply in all areas; on 30th November, 1948, the respective numbers were 257 and 54. It is interesting to note that on 26th February, 1948, at a time when employment is low for most construction tradesmen, vacancies for plasterers numbered 122, applicants 90. The high demand in Ontario (91 vacancies as against 18 applicants) accounted for this condition, since, in all other regions, there was a moderate surplus of applicants. National Employment Service figures do not give the full employment picture, since an appreciable number of placements are also made by the unions. It would appear, from the foregoing, that employment opportunities for plasterers are quite good.

Apropos of a longer work-year, it is interesting to observe that some current newspaper advertisements are offering year-round employment to plasterers.

Early in 1946 the National Joint Conference of the Construction Industry estimated that the apprenticeship needs for plasterers for a four-year period would total 650, (or 163 per annum). On a provincial basis, this would involve an annual intake as follows: P.E.I. 1; N.S. 16; N.B. 5; Que. 59; Ont. 51; Man. 6; Sask. 4; Alta. 7; B.C. 14.

Assuming the correctness of the estimate made by the Conference, of 3,749 known plasterers, a statistical projection, based on a normal working period of 35 years, a mortality of 8 per thousand, and an average increase of 1.5 per cent, gives an annual demand for 190 new-comers. The high proportion in the upper-age group, shown above, would increase this by, possibly, 80 more retirements requiring replacement. Thus an annual intake of 270, rather than the 163 estimated by the Conference, might, under normal conditions, be absorbed. There has been, however, little that could be termed "normal" about the activity of the construction industry for the past 30 years.

Should the excess of vacancies over applicants continue, there will be a demand for more recruits to plastering. Nevertheless, one union local found it advisable to issue a warning, during the 1946-47 winter, against what it considered undue local expansion of training, involving the admission of excess apprentices during the slack season.

It will be necessary for counsellors to watch the local situation carefully, and to consult with union and employer officials in this and in the other building trades. The outlook after the present rush of construction is completed cannot be foreseen.

Qualifying Factors Affecting Future Employment

Besides the factors affecting the construction trades generally, the type of building and the materials used will influence the demand for plasterers. Where wallboard is applied to interiors, and merely painted or papered, the plasterer is not needed. Nevertheless, plastering is often done over such materials. Exterior plain stucco work is likely, as in the past 25 years, to be used extensively in domestic architecture, and high lumber and brick costs may increase this use. Pre-fabricated buildings may be, and often are, finished with such an exterior coat after being set up.

Summary

Current conditions and planning point to a steady but limited demand for plasterers for the next few years. This demand will vary locally, influenced by types of construction, population and industrial changes, and general building costs. Trade organizations should therefore be consulted as to the local situation.

Those desiring training for this trade should be made fully aware of the possible working season, and of the marked effects of business cycles on the industry generally in the past years.

This trade may possibly be affected by the increasing use of wallboard with prepared surfaces, improved varieties of which have recently come on the market. Caution should be exercised, therefore, when considering the present high demand, steady though it has been in the post-war period.

REFERENCES

Encyclopaedia Britannica, Vol. 18, *Plaster Work.*

U.S. Department of Labor, *Job Descriptions in the Construction Industry*, Vol. II, 1936.

AUDIO-VISUAL MATERIAL

Readers desiring information on film sources, available utilization material, and the organization of local film libraries may obtain it from the National Film Board offices listed in Monograph I, *Carpenter.*

DEPARTMENT OF LABOUR

Economics and Research Branch

OTTAWA, 1949

OTTAWA
EDMOND CLOUTIER, C.M.G., B.A., L.PH.,
KING'S PRINTER AND CONTROLLER OF STATIONERY,
1949

CANADIAN OCCUPATIONS

★

PAINTER

(Construction and Maintenance)

MONOGRAPH 4

REVISED 1957

DEPARTMENT OF LABOUR, CANADA

CANADIAN OCCUPATIONS

★

PAINTER

(Construction and Maintenance)

MONOGRAPH 4

REVISED 1957

HON. MILTON F. GREGG, V.C., MINISTER
A. H. BROWN, DEPUTY MINISTER

DEPARTMENT OF LABOUR, CANADA

PRINTED IN CANADA

45

Price: 10 cents

FOREWORD

During recent years there has been a steadily increasing demand for up-to-date information on occupations.

This demand comes from youth faced with the need of choosing an occupation and of selecting the type of training required; from parents, teachers and other counsellors; from workers shifting to other occupations; from employment service officers; from directors of personnel and union officials, and from other quarters.

This series of monographs and an accompanying series of pamphlets, the latter containing similar information in a condensed form, are attempts to meet this demand. These publications are designed for general use and cover a wide range of occupations, including professions. They indicate, among other things, the nature of the occupation or group of occupations, entrance and training requirements, working conditions and opportunities in each.

The staff of the Occupational Analysis Section has prepared this series with the generous assistance of representatives of management, trade unions, and professional associations. The co-operation of the Unemployment Insurance Commission, the Vocational Training Branch of the Department of Labour, and the Dominion Bureau of Statistics is gratefully acknowledged.

Acknowledgment is also made of the assistance obtained from numerous publications on occupations prepared in Canada and in other countries.

DIRECTOR,
Economics and Research Branch,
Department of Labour.

January 1957.

PAINTER

Photo: N.F.B.

HISTORY AND IMPORTANCE

The application of pigments to exterior and interior surfaces, particularly those of wood, has served to decorate and preserve the dwellings of man since very early times.

In Canada, where the use of wood in construction has always been very extensive, and where extremes of heat and cold must be borne by buildings, the work of the construction and maintenance painter is a basic necessity to an extent greater than that in more equable climates. A house whose exterior trim and sashes are not repainted in time will quickly deteriorate, and a year or two of neglect in this respect may involve replacement of much expensive woodwork. Interiors, too, suffer both in appearance and in actual material if paint and varnish are not renewed at the proper time. New structures must be protected at once. Metal requires protection similar to that given wood.

This protective and decorative work is not simply a matter of using a ready-mixed paint and a cheap brush. The pigment must be correctly mixed with medium and thinner, both in content and colour, and the preparation of the surface, the application of the several coats, the uniformity of the mixture, the use of the proper type of brush for each part of the work, the avoidance of intrusion on areas not to be painted — all these are dependent on the knowledge and skill of the craftsman who does the work. Most of us can distinguish a "good paint job" from a poor or bad one.

The craft has long been organized in the older lands; the hall of the Painters' Company in the City of London has long served as a wonderful example of 17th century woodwork, testifying to the importance, artistic taste, and prosperity of the trade in that era. The trade has always preserved high standards of reliability and efficiency, and these traditions are carried on by its organized bodies in North America.

This monograph deals only with those painters engaged in building construction and maintenance. The large number of persons in manufacturing engaged in routine painting work, often requiring a minimum of skill, are frequently associated with the labour organization of the industry they work for rather than with

the painter's craft union, nor are portrait, landscape, genre or other artists included here.

DUTIES

The *Dictionary of Occupational Titles* defines "Painter (construction)" as follows: "Performs all classes of painting work, such as painting the exterior of houses, sheds and other structures, and painting and decorating the interiors of buildings. Mixes paint and matches colours by stirring together the proper proportions of pigment, base and thinner. Uses brushes and spray gun to apply paint. Erects working scaffold. Removes old paint by applying liquid paint remover or by heating surface with blowtorch and scraping off paint."

The "Painter (maintenance)" performs duties similar to the above, but is employed solely by one establishment on maintenance work.

QUALIFICATIONS

As in all skilled trades, the would-be apprentice should have an education above the elementary level, and would be wise to prolong this as far as possible, and to include any available technical courses closely related to the occupation. Since many painters operate on their own account, arithmetic and bookkeeping should be given special attention.

While painting does not involve much handling of heavy materials, it requires a physique capable of long work in a standing position, an ability to work in high places, strong wrists, and a steady hand. A good eye for colour and for surfaces, an ability to study harmonies and to match shades, and a general knowledge of the duties of other construction crafts in their relation to his own activities are all required of a construction painter. If he studies the physical and chemical qualities of pigments, varnishes and media, he is likely to find his work giving increased satisfaction.

Basic personal qualities required are tact, courtesy, and tidiness, since work will often be done in occupied homes.

TRAINING

This trade is best learned through serving as an apprentice under the guidance of a skilled painter. The apprenticeship period lasts from three to four years, depending on the province. Training includes practical work on the job, as well as classroom instruction at a vocational school. In some provinces, apprentices in rural districts are given the required theoretical instruction by correspondence. At the end of the training period, the apprentice, if successful, is certified as a qualified journeyman.

ENTRY INTO OCCUPATION

The number of apprentices is related to that of journeymen, and aspirants for entry should apply to the National Employment Service for information as to the local situation with regard to placement opportunities.

EARNINGS

Wage rates for painters vary with the locality and, of late years, have been subject to regular upward changes. Information on their earnings, as well as those of many other skilled tradesmen, can be obtained from the annual report of the Department of Labour, *Wage Rates and Hours of Labour in Canada*. In October 1956, the following prevailing hourly rates were being paid to painters in the construction industry:

Newfoundland	
St. John's	$1.45
Prince Edward Island	
Charlottetown	1.05
Nova Scotia	
Halifax	1.53
Sydney	1.40
New Brunswick	
Moncton	$1.20
Saint John	1.47
Quebec	
Chicoutimi	1.35
Montreal	1.80
Quebec	1.50
Three Rivers	1.40

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benefits under Unemployment Insurance and Workmen's Compensation legislation. Vacations with pay are common.

Work may be outdoors or indoors.

The cost of the working kit is not great, and it is possible to set up on one's own account with small capital.

Outside of the seasonal slack time, the hazards common to all occupations using ladders and scaffolding, and those incident to construction work generally, and the necessity of much standing and some stooping or recumbent work, there are no marked disadvantages in this trade. Care must be taken to avoid dangers to health inherent in the handling and use of the paints and varnishes.

The positive steps taken by both industry and government to lengthen the work year of construction tradesmen has resulted in painters having more work to do in the winter months than they formerly had.

ORGANIZATIONS

Painters in construction are usually members of craft unions. In other industries they may belong to industrial unions.

TRENDS

Number in Occupation

The 1951 census showed a total of 47,158 painters, decorators and glaziers in Canada. Included in this total are 885 women. Between 1941 and 1951, the number of painters, decorators and glaziers increased by approximately 20 per cent.

Distribution by Industry and Province

In 1951, the majority (58 per cent) of painters, decorators and glaziers were employed in the construction industry; the next largest field of employment was manufacturing (27 per cent).

The following table, which is based on the 1951 census, shows the numerical distribution by industry of painters, decorators and glaziers:

Primary Industries		144
Mining, Quarrying & Oil Wells		230
Manufacturing		12,519
Wood Products	1,321	
Iron & Steel Products	2,029	
Transportation Equipment	3,917	
Electrical Apparatus & Supplies	805	
Other	4,447	
Construction		27,000
Transportation		1,240
Trade (Wholesale & Retail)		2,160
Service		3,473
Community	1,020	
Government	1,652	
Other	801	

In 1951, Quebec and Ontario together accounted for 71 per cent of all painters, decorators and glaziers. The percentage distribution by province for that year is as follows:

	%		%
Newfoundland	1.5	Ontario	40.3
Prince Edward Island	0.6	Manitoba	5.6
Nova Scotia	4.0	Saskatchewan	2.3
New Brunswick	2.6	Alberta	4.5
Quebec	30.7	British Columbia	7.9

Future Employment Prospects

Opportunities for painters will depend, to a large extent, on what happens in the construction industry. In the past ten years, this industry has shown remarkable growth and has provided many openings for skilled tradesmen. During this time, large numbers of homes, offices and factories have been built and the demand still remains strong. A continuation of this demand will make for good opportunities for painters and other construction workers.

REFERENCES

The Guidance Centre, Ontario College of Education, Toronto, Monograph, *Painter* (1955).

Department of Education, Victoria, B.C., "B.C. Occupations Series", *Painter* (1947).

Ministry of Labour and National Service, London, England, "Choice of Careers — New Series", No. 27, *The House Painter and Decorator* (1952).

PERIODICALS

Brotherhood of Painters, Decorators and Paperhangers of America, *The Painter and Decorator* (Monthly).

LOCAL INFORMATION

LOCAL INFORMATION

"CANADIAN OCCUPATIONS" SERIES

Monographs and Pamphlets

The monographs listed below, accompanied by pamphlets, except in the case of numbers 12, 13 and 39, have been published to date.

(1) Carpenter
(2) Bricklayers and Stone-Masons
(3) Plasterer
(4) Painter
(5) Plumber, Pipe Fitter and Steam Fitter
(6) Sheet-Metal Worker
(7) Electrician
(8) Machinist and Machine Operators (Metal)
(9) Printing Trades
(10) Motor Vehicle Mechanic
(11) Optometrist
(12) Social Worker
(13) Lawyer
(14) Mining Occupations
(15) Foundry Workers
(16) Technical Occupations in Radio and Electronics
(17) Forge Shop Occupations
(18) Tool and Die Makers
(19) Railway Careers

Careers in Natural Science and Engineering: (20-35, one booklet)

(20) Agricultural Scientist
(21) Architect
(22) Biologist
(23) Chemist
(24) Geologist
(25) Physicist
(26) Aeronautical Engineer
(27) ——
(28) Chemical Engineer
(29) Civil Engineer
(30) Electrical Engineer
(31) Forest Engineer and Forest Scientist
(32) Mechanical Engineer
(33) Metallurgical Engineer
(34) Mining Engineer
(35) Petroleum Engineer

(36) Hospital Workers (Other than Professional)
(37) Draughtsman
(38) Welder
(39) Careers in Home Economics
(40) Occupations in the Aircraft Manufacturing Industry
(41) Careers in Construction

Filmstrips

The Department of Labour has prepared, to date, the following occupational filmstrips in collaboration with the National Film Board. A manual has been prepared as an accompaniment to each filmstrip. These may be purchased from the National Film Board, Box 6100, Montreal, or from any one of its regional offices.

Plumber, Pipefitter and Steamfitter
Careers in the Engineering Profession
The Social Worker
Technical Occupations in Radio and Electronics
Bricklayer and Stone-Mason
Printing Trades
Careers in Natural Science
Careers in Home Economics
Motor Vehicle Mechanic

DEPARTMENT OF LABOUR

Economics and Research Branch

CANADA, 1957

HULL
EDMOND CLOUTIER, C.M.G., O.A., D.S.P.
QUEEN'S PRINTER AND CONTROLLER OF STATIONERY

CANADIAN OCCUPATIONS

★

PLUMBER, PIPE FITTER and STEAM FITTER

★

MONOGRAPH 5

DEPARTMENT OF LABOUR, OTTAWA

CANADIAN OCCUPATIONS

★

PLUMBER, PIPE FITTER and STEAM FITTER

MONOGRAPH 5

HON. HUMPHREY MITCHELL, MINISTER
ARTHUR MACNAMARA, C.M.G., LL.D., DEPUTY MINISTER

DEPARTMENT OF LABOUR, OTTAWA

FOREWORD

During recent years there has been a steadily increasing demand for up-to-date information on occupations.

This demand comes from youth faced with the need of choosing an occupation and of selecting the type of training required, from parents, teachers and other counsellors; from workers shifting to other occupations; from employment service officers; from directors of personnel and union officials, and from other quarters.

This series of monographs and an accompanying series of pamphlets, the latter containing similar information in a condensed form, are attempts to meet this demand.

These publications represent an expansion of an earlier series issued by the Department of Veterans Affairs to assist members of the armed forces returning to civilian life following the end of the war. These current series, designed for general use, cover a wide range of occupations, including professions. They indicate, among other things, the nature of the occupations or group of occupations, entrance and training requirements, working conditions and opportunities in each.

The monographs have been prepared by our research staff working on occupations, with the generous help and advice of officials of the Unemployment Insurance Commission, Vocational Training Branch and Bureau of Technical Personnel of the Department of Labour, Dominion Bureau of Statistics, Provincial Departments of Education and of Labour, employers' associations, trade unions, professional associations, and other government and non-government bodies.

Grateful acknowledgment is made of this assistance and that obtained from numerous publications on occupations prepared in Canada and in other countries.

DIRECTOR,
Economics and Research Branch,
Department of Labour.

July, 1949.

PLUMBER, PIPE FITTER and STEAM FITTER

HISTORY AND IMPORTANCE

The conveyance of water into buildings by means of pipes was a common practice under the Roman civilization. Drinking, bathing and cooling facilities, both private and public, were provided by a system of lead pipes, fed by gravity from aqueducts. Since no power-driven pumps existed until the application of steam in the 18th century to this work, it is not surprising that no progress was made in the centuries between the Roman age and that of steam. England and France, between the 15th and 17th centuries, availed themselves of the gravity supplies obtainable, and such waterworks as those of the New River Company in London were the precursors of modern plumbing.

Since lead (plumbum) was the only material workable for interior piping, and the lining of cisterns, with the possible exception of copper, the Roman craftsman dealing with such works was known as a "plumbarius", and the name has been retained in varying forms as that of his modern counterpart.

With the advent of improved steam power, of threaded metal piping of iron and other metals, and an advance in scientific knowledge of the relation of sanitation to epidemics, the 19th century brought rapid advances in water supply and sewage disposal. Indoor water closets became common in England early in that century, and quickly spread to the more advanced European countries; baths became regular equipment for all but the poorest homes in urban areas where a central water supply was installed, and even in some villages. North America,

then largely agricultural and much absorbed in internal expansion, was somewhat behind in these developments; some sections of the population bitterly opposed installation of a bath in the White House, in the 1850's. Hot-water and steam-heating apparatus began to replace stoves and fireplaces in the 1860's.

Systems involving power pumps and pressure tanks were developed for buildings having no municipal water supply, and the use of cesspools and septic tanks for sewage disposal made it possible for rural residents to have, at what is now a comparatively small expenditure, the sanitary conveniences of a city. Windmills, water-power rams, and gasoline and electric motors provided power.

The 20th century has produced a multiplication of conveniences in the bathing and sanitary equipment of hotels and the homes of the prosperous, especially in North America. The standard set was a bathroom and "toilet" to each bedroom; and the wealthy vied with one another in the cost and luxury of their appliances and rooms.

All this created an increasing demand for the services of plumbers, both in installing and repairing equipment. New techniques developed as new materials came into use, and the plumber's duties often involved pipe fitting and steam fitting, laying out and installing water and sewerage systems for rural buildings, and connecting water systems with power sources, including electric motors, gasoline engines and windmills, and with stoves, furnaces, or electric heaters for hot-water supply.

It is thus impossible to make a clean-cut separation between plumbers, steam fitters and pipe fitters. It can be stated with some truth, however, that there is a separation of functions in large centres to a much greater extent than in smaller ones.

The increasing dependence of society on skilled plumbers is very clear. In 1870 they formed 2 per cent of building tradesmen in the U.S.A.; in 1890, 5.4 per cent; in 1930, 12 per cent.

Photo N.F.B.

An Advanced Apprentice Plumber

DUTIES

The following is a summary of the duties of plumbers: A plumber engaged in making service connections: Assembles and installs air, gas, water and waste-disposal systems; cuts openings in walls for pipes; bends, cuts, reams and threads pipe; caulks joints; wipes joints; pours molten solder over joints and spreads and shapes solder with a cloth; tests joints and pipe system for leaks by filling pipe with water under pressure and checking with a gauge for fall in pressure; installs gas, water and sanitary fixtures and equipment with their supports, hangers or foundations.

If engaged in maintenance, he keeps the plumbing system of an establishment in good order by performing duties such as installing or repairing pipes and fixtures, and replacing washers on leaky faucets.

If his work is pipe fitting, he installs, bends, cuts and threads air, water and gas pipe and fittings; locates position of pipe by measuring; cuts holes in walls or floor; bolts or screws pipe hangers to supports; cuts large pipe to correct length with chisel and hammer, or acetylene torch, and small pipe with pipe-cutting machine; threads pipe with stock and dies; bends pipe by hand-driven or power-driven machines; assembles pipe with couplings and fastens pipe to hangers; if pipe has large flange fittings, places gasket in flanges and bolts pipes together; caulks pipe, makes hydrostatic pressure tests of complete work.

He may be required to do electric arc or acetylene welding to unite sections of steel pipe and pipe fittings.

As a steam fitter (pipe fitter, steam) he may install pipes and equipment that must withstand high pressure and low pressure for the distribution of steam; assemble and install steam furnaces, radiators, heating and ventilating units, and thermostatic systems, oil burners and stokers.

Other pipe fitters specialize in refrigeration systems, sprinkler systems, and pneumatic tube systems. Installation of piping on ships and boats is done by marine pipe fitters.

Brass, copper, lead, iron, steel, aluminium and earthenware pipes, a great variety of fittings, and even some sheet metal, all are materials likely to be dealt with by plumbers, steam fitters and general pipe fitters.

QUALIFICATIONS

The lower age limit for apprenticeship is 16 (in British Columbia 15). Ontario, Manitoba and Alberta have an upper age limit of 21. The two last make some exceptions.

A plumber, steam fitter or pipe fitter must be able to plan and visualize a job, to make estimates of costs, to deal with the public, and in many cases conduct a business. A knowledge of mathematics is necessary, with as much technical and academic education beyond the elementary level as can be obtained. Some chemistry, physics, and draughting should be included.

Heavy articles must be handled; hands and wrists must be strong. It is safe to say that anyone employed in plumbing and pipe fitting must have good muscular strength. He must have good eyesight. Physically handicapped persons are not adapted for this trade.

Since any poor workmanship is bound to cause grave inconvenience to the customer, and affect the reputation of the mechanic himself, a strong sense of responsibility is necessary. Courtesy, and a pleasant manner, will do much to make for success, since a great deal of repair and replacement work is done in inhabited homes, often in conditions of urgency.

Finally, an ability to study, to learn the properties of the materials used, and an interest in new developments, are all necessary to the modern mechanic. An ability to understand and operate under municipal bylaws is also necessary.

There are no women in this occupational group.

TRAINING

Like other skilled construction trades, this is learned by apprenticeship. In some provinces a probationary period precedes a formal training period under inden-

tures. Steam fitting is a separate trade for apprenticeship. All courses last five years except in the case of Quebec, where four years is the regular period. The probationary period in Quebec is one year; in all other provinces, six months.

A typical course, approved by masters and journeymen, includes practical work along with study of mathematics and drawing, science, trade terms, care and use of tools, care and use of materials, safety and first aid, and miscellaneous information on: house sewers and drains, stacks and branches; backing of fittings; ventilation; sewage disposal; water supply (sources and mains, outside and inside); domestic hot water, tanks and heaters; soldering and lead work, sheet lead work, wiping lead pipe work; sheet-metal work; installing fixtures, setting fixtures; installing traps, stops and cocks; installing trim and pipe rail; gas fitting; cooking and heating appliances; industrial heating appliances; drainage system repairs; faucets and valves; supply system repairs; gas repairs.

In most provinces formal instruction is given in classes, or may be taken by correspondence courses. Some allowance may be made, assessed in each individual case, for success in courses of technical education on the trade, in either plumbing or steam fitting. Periodic tests are usually given to apprentices.

ENTERING OCCUPATION

The number of apprentices taken in is governed by the number of journeymen in the firm's employ. For practical reasons, the proportion maintained is unlikely to be increased. It varies considerably by provinces.

Contact with the Youth Section of the National Employment Service should be established as soon as a desire to enter the trade has been indicated, in order that the possibility of obtaining an opening may be explored. In a few cases personal contacts may exist to an extent making this unnecessary.

As the control of apprenticeship is on a provincial basis, enquiry should be made as to any changes in regulations of the Director of Apprenticeship in each province. In Quebec, local commissions are the governing basis. Montreal, Chicoutimi, Sherbrooke and Hull are among centres having such commissions. Prince Edward Island has not yet designated this group for compulsory apprenticeship, but legislation exists which would make this possible at any time.

EARNINGS

Hourly rates for journeymen are fixed by local agreement between union and employers.

Some current rates are:

Charlottetown	$0.85	Hamilton	$1.60
Halifax	1.27	London	1.46
Saint John	1.20	Windsor	1.65
Moncton	1.15	Winnipeg	1.50
Quebec	1.00	Regina	1.45
Montreal	1.55	Calgary	1.45
Ottawa	1.60	Edmonton	1.50
Toronto	1.75	Vancouver	1.65

These may, of course, be regarded as minima. In some cases individual employers pay more.

Apprentices receive a percentage of journeyman's rates, rising annually or semi-annually to an average of 80 per cent. This percentage varies according to provincial practice.

The range is:

	Per cent		Per cent
Nova Scotia	45—90	Manitoba	25—80
New Brunswick	35—80	Saskatchewan	50—85
*Montreal	40—70	Alberta	30—75
Ontario	30—85	B.C.	25—85

* Quebec province has no general rate.

Journeymen probably earn at least $2,000 a year now, and in areas of higher pay rates considerably more.

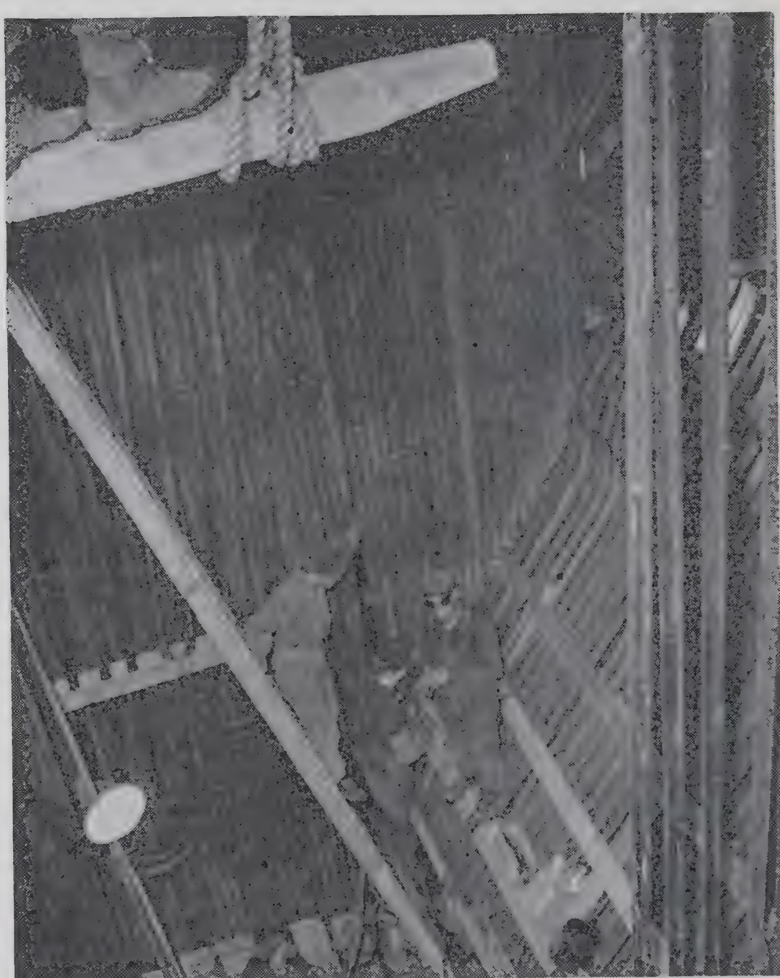

Photo N.F.B.

Pipe-fitters at work

This trade is less affected by seasonal conditions than are most in the construction industry. The 1941 average of employment was exceeded in the industry by electricians only. It is likely that present conditions provide an appreciably longer working time in the year.

ADVANCEMENT

The progress of an apprentice is recognized by annual increases in pay and responsibility. On completion of his term and on passing a trade test, he is classed as a journeyman. Advancement from journeyman may be to foreman or superintendent, or to the conduct of his own business as a master plumber or heating contractor. In some cases municipalities impose licensing restrictions on master and journeyman plumbers.

Other possibilities are employment as sanitary inspector or as salesman of sanitary supplies. With university training in civil engineering, a plumber might become a sanitary engineer.

RELATED OCCUPATIONS

The profession of sanitary engineer, and the trades of machinist, sheet metal worker, stationary engineer, and refrigeration engineer all involve some of the same knowledge and skills as that of the plumbing group. Salesmen of plumbing supplies, plumbing inspectors, and teachers of plumbing in technical schools, need to know this trade.

ADVANTAGES AND DISADVANTAGES

One advantage, as indicated above, is the relatively high demand for the services of plumbers and fitters.

The individual worker is under little, if any, supervision on many jobs, and has thus both responsibility and some independence.

There is little monotony in the work, and each job presents opportunity for planning and initiative.

Apprenticeship regulations and union organization give a large measure of security. This occupation shares in the benefits of Unemployment Insurance and Workmen's Compensation legislation.

The possibility of setting up one's own business, when the necessary capital has been saved, is an incentive to craftsmen in these trades.

Against these advantages must be offset the fact that much work must be done in unheated buildings, and in uncomfortable working positions. Heavy articles must often be lifted.

There is no question of the fact that this work is one in which hands and clothing alike will be subject to contact with dirt, grease, tar and other unclean materials.

It may be, at times, necessary to work away from home for long or short periods.

ORGANIZATIONS

Labour organizations for these trades are craft unions.

Some tradesmen employed in small numbers in industrial plants may be members of appropriate industrial unions.

Master plumbers have the National Association of Master Plumbers and Heating Contractors of Canada, Inc. Branch associations exist in New Brunswick, Manitoba, Alberta, Saskatchewan and British Columbia.

The Ontario Association of Plumbing Inspectors and Affiliates is open to master and journeymen plumbers as well as to public officials administering sanitary laws and to manufacturers of sanitary goods.

Plumbers and steam fitters may belong to industrial unions in factories where they are employed on maintenance, or may, especially in Quebec, affiliate themselves with unions covering all construction trades.

TRENDS[1]

Number in Occupation

The 1941 census gives a total of about 16,000 employed plumbers and pipe fitters, and about 19,500 for the whole trade. This indicates that there were 3,500 engaged in the trade on their own account.

Distribution by Industries

The above-mentioned were distributed in the following industrial groups:

Primary	642	Transportation	520
Manufacturing	4,843 (24.9%)	Trade & Commerce	217
Construction	12,797 (65.7%)	Service	405
		Sundry	60

Growth

The census figures for plumbers and pipe fitters are:

1921	12,428
1931	17,471 (increase over 40%)
1941	19,484 (increase over 11.5%)

(about 1,500 more were on active service in 1941)

This compares with population increases in the period 1921-31 of about 18 per cent, and 1931-41 of about 11 per cent. It is evident that the construction activity of the "boom" years of the 1920's caused large accessions to the trade, and that, even in the "depression" years, demand for its services grew in proportion to population increase.

The war years caused entrants to the trade to be very few, and early in 1946 the National Joint Conference of the Construction Industry estimated that there were just over 10,000 plumbers and steam fitters in that industry, and that there was a shortage of approximately 4,000. As this industry represents, as previously indicated, about two-thirds of the field of activity of this trade, it would appear that there were not more than 15,000 plumbers available in Canada, and that a shortage of about 6,000 existed.

[1] For information on trends in the construction industry generally, the reader is referred to Part I of Monograph 1, "Carpenter".

Age Groups

In 1941 the upper age groups in this trade comprised:

Over 70	199	
65—69	525	
55—64	2,592	3,316
45—54		4,422
Total 45 years and over		7,738

These figures would indicate a need for a high rate of replacement of those dying and retiring, and would partly account for the reduced number of those in the construction industry as between 1941 and 1946. The proportion of the 1,500 shown as on active service in 1941 who returned to the trade would hardly fill this need.

Need for Workers

Perhaps the safest basis on which to estimate, conservatively, the annual need for new entrants is the estimate of the National Joint Conference of the Construction Industry, above referred to. This called for 2,800 apprentices in the years 1946-1949; this represents about two-thirds of the plumbing and heating trade employment, and therefore 4,200, or about 1,050 per year, would seem to be a reasonable estimate of entry requirements.

As at December 31, 1947, there were 71 veterans (only) registered for training in Canadian Vocational Training Schools in plumbing and steam fitting.

Enrolled in these occupations in industry between April 1, 1944, and December 31, 1947, were 1,546 veterans. Most of these would have entered in 1946-47.

The last figure represents those who actually entered the trade, since the Canadian Vocational Training course must be followed by apprenticeship. Allowance must be made for boilermakers in using these totals.

No figures are available on non-veterans, and as 16 is the minimum age, and 21 the normal maximum, for entry, it is possible that the number may equal that of veterans.

There is no indication that there has hitherto been any excessive entry. Enquiry should be made, however, locally, in view of great variations in conditions.

Labour Demand and Supply

On September 30, 1948, there were 386 vacancies and 280 applicants, and as at December 31, 1948, there were 148 vacancies and 688 applicants registered at National Employment Service offices in plumbing and steam fitting. On the former date vacancies exceeded applicants in Quebec, Ontario, and in the Prairie region; the Maritimes and Pacific region had a proportionately large but numerically small excess of applicants, (46 and 62 respectively). All these figures of course refer to men with some trade standing.

Though an appreciable number of engagements are made through other channels, it is reasonable to assume that the general picture is much as indicated in the figures quoted.

It must be pointed out here that, in recent months, the number of applicants to the National Employment Service for apprenticeship (all trades) greatly exceeds that of vacancies (September 30, 1948, 304 vacancies, 1,095 applicants). This condition may apply to plumbing and steam fitting in common with other skilled trades. Enquiry at the local National Employment Service office or of the local union is therefore most advisable, since local variations from the total picture may be considerable.

Future Employment Prospects

Since only 76 per cent of urban dwellings, and about 7 per cent of rural homes, had baths or showers in 1941, as shown by the census, while only 8 per cent of farm homes had flush toilets, there would seem to be a considerable backlog of potential demand for the services of plumbers. Moreover, new construction, slowed up as it has been by material shortages and costs, is likely to be spread over a reasonably long period. The great change in farm incomes brought about by the war will have a reaction, perhaps delayed by the cost factor, in increased demand for the facilities shown above as lacking.

There will always be repair work, increasing in volume in proportion to construction.

REFERENCES

The following are useful reference material on this occupation:

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Ontario College of Education, Toronto, Ontario, Vocational Guidance Centre Monograph, *Plumber,* (1946). This gives much detail.

Department of Education, Victoria, B.C., *Analysis of the Plumber's Trade for Apprentice Training,* (undated).

U.S. Department of Labor, Bureau of Labor Statistics, *The Job of the Plumber, Construction* — Occupational Brief No. 76, (1945).

U.S. Department of Labor, Occupational Outlook Division — *Employment Outlook, Plumbers, Construction,* (1946).

AUDIO-VISUAL MATERIAL

Readers desiring information on film sources, other available material, and the organization of local film services may obtain it from the National Film Board offices listed in Monograph 1, "Carpenter".

LOCAL INFORMATION

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DEPARTMENT OF LABOUR

Economics and Research Branch

OTTAWA, 1949

OTTAWA
EDMOND CLOUTIER, C.M.G., B.A., L.PH.,
KING'S PRINTER AND CONTROLLER OF STATIONERY,
1949

CANADIAN OCCUPATIONS

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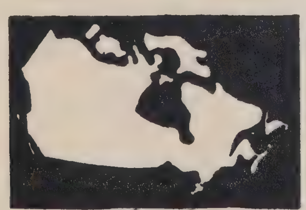
PLUMBER, PIPE FITTER and STEAM FITTER



MONOGRAPH 5

REVISED 1957

DEPARTMENT OF LABOUR, CANADA

CANADIAN OCCUPATIONS

★

PLUMBER, PIPE FITTER and STEAM FITTER

MONOGRAPH 5

REVISED 1957

HON. MILTON F. GREGG, V.C., MINISTER

A. H. BROWN, DEPUTY MINISTER

DEPARTMENT OF LABOUR, CANADA

PRINTED IN CANADA

45

Price: 10 cents

FOREWORD

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The staff of the Occupational Analysis Section has prepared this series with the generous assistance of representatives of management, trade unions and professional associations. The co-operation of the Unemployment Insurance Commission, the Vocational Training Branch of the Department of Labour, and the Dominion Bureau of Statistics is gratefully acknowledged.

Acknowledgment is also made of the assistance obtained from numerous publications on occupations prepared in Canada and in other countries.

DIRECTOR,
Economics and Research Branch,
Department of Labour.

January 1957.

PLUMBER, PIPE FITTER and STEAM FITTER

HISTORY AND IMPORTANCE

The conveyance of water into buildings by means of pipes was a common practice in Roman times. Drinking, bathing and cooling facilities, both private and public, were provided by a system of lead pipes, fed by gravity from aqueducts. Since no power-driven pumps existed until the application of steam in the 18th century to this work, it is not surprising that no progress was made in the centuries between the Roman age and that of steam. England and France, between the 15th and 17th centuries, availed themselves of the gravity supplies obtainable, and such waterworks as those of the New River Company in London were the precursors of modern plumbing.

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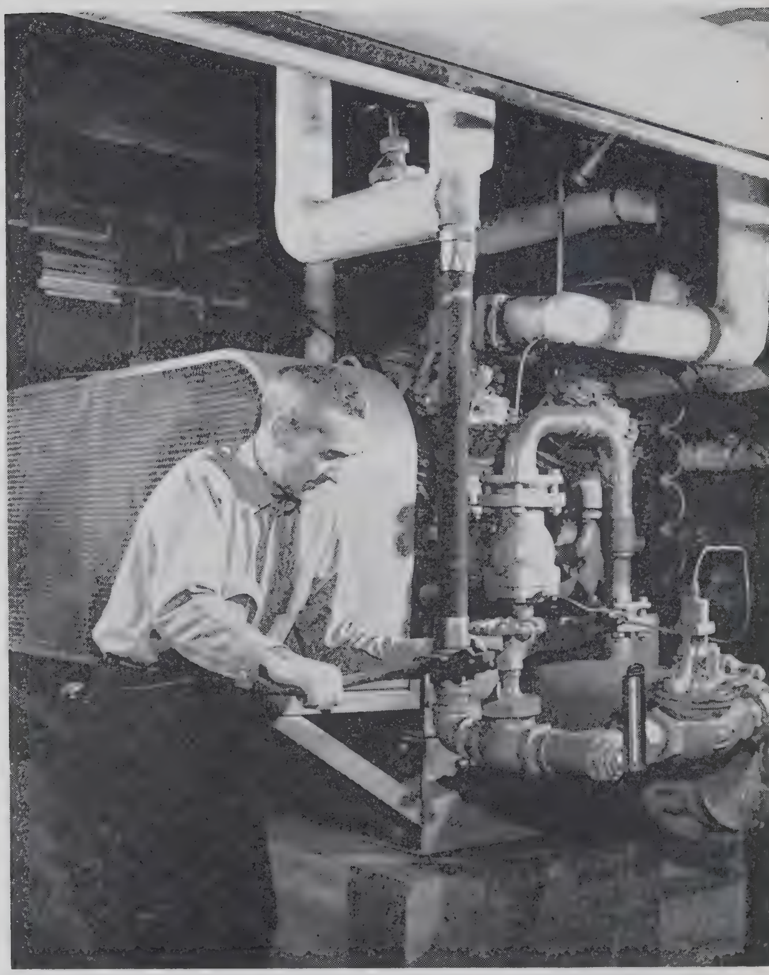

Photo: N.F.B.

Installation of air-conditioning equipment — a specialized field.

1860's. The first half of the 20th century saw a tremendous increase in the use of plumbing facilities in homes, offices, hotels, factories and other buildings. New techniques developed as new materials came into use. All this created an increasing demand for the services of plumbers, pipe fitters and steam fitters, both in installing and repairing equipment.

Plumbers thus form an important group in the building trades. The high level of construction during the last decade has made heavy demands on the supply of skilled tradesmen for plumbing and heating installation, and there is a need for apprentices in this field.

DUTIES

It is difficult to make a clean-cut separation between plumbers, steam fitters and pipe fitters. It can be stated, however, that there is a separation of functions in large centres to a much greater extent than in smaller ones.

The following is a summary of the duties of plumbers: assembles and installs air, gas, water and waste-disposal systems; cuts openings in walls for pipes; bends, cuts, reams and threads pipes; caulks joints; wipes joints; pours molten solder over joints and spreads and shapes solder with a cloth; tests joints and pipe system for leaks by filling pipe with water under pressure and checking with a gauge for fall in pressure; installs gas, water and sanitary fixtures and equipment with their supports, hangers or foundations.

Plumbers also maintain the plumbing systems of homes, offices and factories in good order by performing duties such as installing or repairing pipes and fixtures.

Pipe fitting is part of plumbing but it is also frequently practised as a separate, specialized trade. The pipe fitter installs, bends, cuts and threads air, water and gas pipe and fittings; locates position of pipe by measuring; cuts holes in walls or floor; bolts or screws pipe hangers to supports; cuts large pipe to correct length with chisel and hammer, or acetylene torch, and small pipe with pipe-cutting machine; threads pipe with stock and dies; bends pipe

by hand-driven or power-driven machines; assembles pipe with couplings and fastens pipe to hangers; if pipe has large flange fittings, places gasket in flanges and bolts pipes together; caulks pipe, makes hydrostatic pressure tests of completed work. He may be required to do electric arc or acetylene welding to unite sections of steel pipe and pipe fittings.

Some pipe fitters specialize in refrigeration systems, sprinkler systems, and pneumatic tube systems. Installation of piping on ships and boats is done by marine pipe fitters.

A steam fitter installs pipes and equipment that must withstand high pressure and low pressure for the distribution of steam; assembles and installs steam furnaces, radiators, heating and ventilating units, and thermostatic systems, oil burners and stokers.

Brass, copper, lead, iron, steel, aluminium and earthenware pipes, a great variety of fittings, and even some sheet metal, all are materials likely to be dealt with by plumbers, steam fitters and general pipe fitters.

QUALIFICATIONS

The lower age limit for apprenticeship is 16 (in British Columbia 15). Ontario and Manitoba have an upper age limit of 21, although exceptions are made.

A plumber, steam fitter or pipe fitter must be able to plan and visualize a job, to make estimates of costs, to deal with the public, and in many cases conduct a business. A knowledge of mathematics is necessary, with as much technical and academic education beyond the elementary level as can be obtained. Some chemistry, physics, and draughting should be included.

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Finally, an ability to study, to learn the properties of the materials used, and an interest in new developments, are all necessary to the modern mechanic. An ability to understand and operate under municipal bylaws is also necessary.

There are no women in this occupational group.

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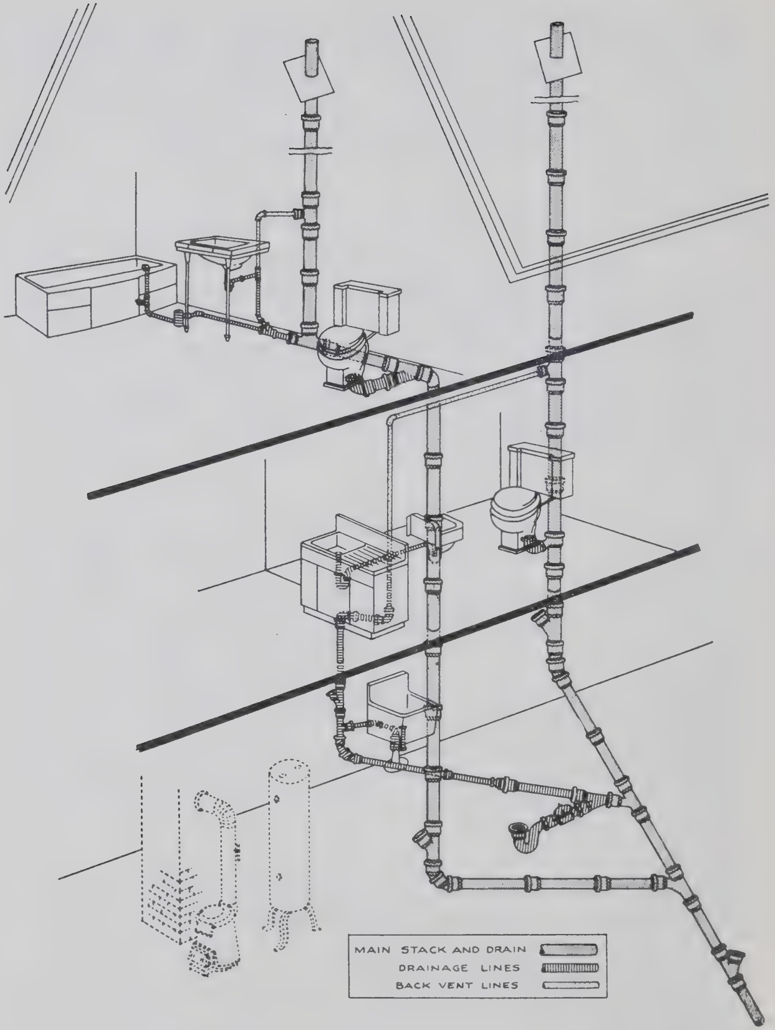
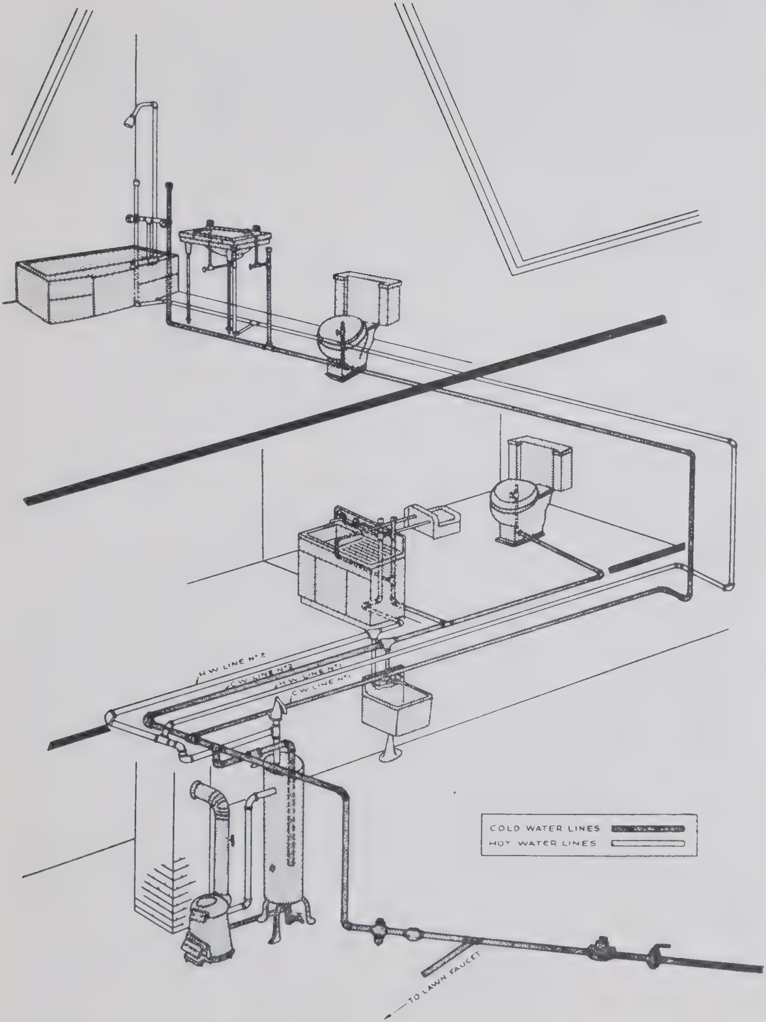
Like other skilled construction trades, plumbing is learned by apprenticeship. In some provinces a probationary period precedes a formal training period under indenture. Steam fitting is a separate trade for apprenticeship in many provinces. Training lasts five years, except in the case of Quebec, Alberta and British Columbia, where four years is the regular period. The probationary period in Quebec is one year, in New Brunswick, six months, and in other provinces, three months.

A typical training program, approved by masters and journeymen, includes practical work along with study of mathematics and drawing, science, trade terms, care and use of tools, care and use of materials, safety and first aid, and miscellaneous information on: house sewers and drains, stacks and branches; backing of fittings; ventilation; sewage disposal; water supply (sources and mains, outside and inside); domestic hot water, tanks and heaters; soldering and lead work, sheet lead work, wiping lead pipe work; sheet-metal work; installing fixtures, setting fixtures; installing traps, stops and cocks; installing trim and pipe rail; gas fitting; cooking and heating appliances; industrial heating appliances; drainage system repairs; faucets and valves; supply system repairs; gas repairs.

Some provinces offer pre-apprenticeship courses, lasting about six months, to give prospective apprentices some preparation before entering the trade. In Quebec, pre-employment classes in plumbing are conducted by Apprenticeship Commissions in Montreal, Sherbrooke, Chicoutimi, Hull and Quebec. Time-credit on apprenticeship is usually allowed for preliminary training in such courses. In most provinces, on-the-job training is supplemented by class instruction at provincial trade or municipal technical schools during each year of apprenticeship. Correspondence courses are also available for those engaged in the trade.



VISUAL LAYOUT - DRAINAGE SYSTEM



VISUAL LAYOUT - WATER SUPPLY SYSTEM

Drawings: CRANE Ltd.

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Information on local conditions and openings for apprentices can be obtained from the offices of the National Employment Service and the Apprenticeship Branches of provincial Departments of Labour. Employers, local union officials and vocational school counsellors can also assist the individual in entering the occupation.

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The following table presents the latest available figures on wage rates for plumbers and steam fitters. Wage rates change frequently. To keep this information current, the reader should refer to local employers, union officials, newspaper employment ads, and the government publication Wage Rates and Hours of Labour in Canada, *Department of Labour, Canada.*

WAGE RATES FOR PLUMBERS AND STEAM FITTERS OCTOBER 1956 (1)

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Nova Scotia	
Halifax	1.86
Sydney	1.85
New Brunswick	
Moncton	1.60
Saint John	1.70
Quebec	
Chicoutimi	1.45
Montreal	2.12
Quebec	1.70
Three Rivers	1.55
Ontario	
Belleville	$2.00
Fort William	2.15
Hamilton	2.40
London	2.30
Toronto	2.44
Manitoba	
Brandon	1.60
Winnipeg	2.25
Saskatchewan	
Prince Albert	2.05
Regina	2.20
Alberta	
Calgary	2.20
Edmonton	2.35
British Columbia	
Prince Rupert	2.40
Vancouver	2.55

(1) Source: Department of Labour, Canada.

An apprentice, at the start, may receive anywhere from 25 to 45 per cent of the prevailing journeyman's rate, depending on the province and on local agreements. This is usually increased every six months, in some provinces every year, until toward the end of training the rate may range from 70 to 90 per cent of the journeyman's scale.

In many cities in Canada in 1955, the 40 and 44-hour week were fairly common. Where union agreements are in effect, time and one-half is usually paid for overtime and double time for recognized holidays and Sundays.

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The progress of an apprentice is recognized by annual increases in pay and responsibility. On completion of his term and on

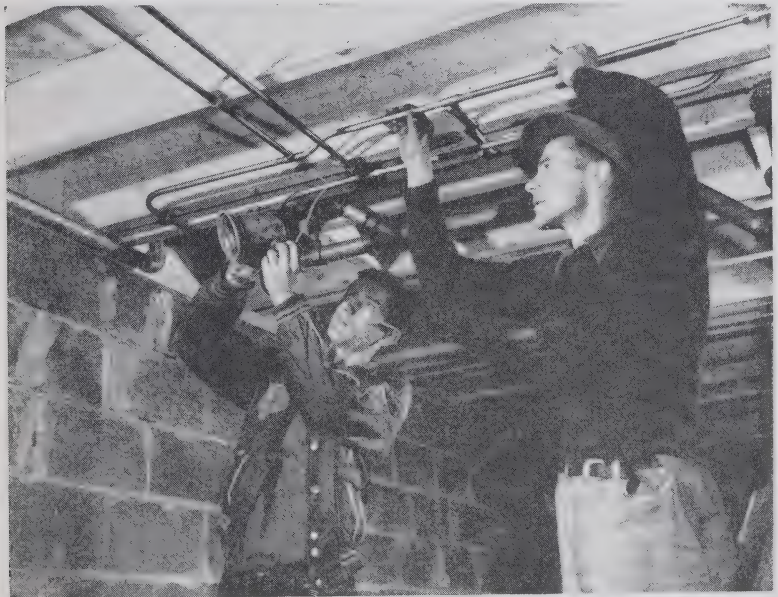

Photo: N.F.B.

Apprentice and journeyman work together.

passing a trade test, he is classed as a journeyman. Advancement from journeyman may be to estimator, foreman or superintendent, or to the conduct of his own business as a master plumber or heating contractor. In some cases municipalities impose licensing restrictions on master and journeyman plumbers.

Other possibilities are employment as a sanitary inspector, a heating engineer or a salesman of plumbing and heating materials or supplies. With university training in civil engineering, a plumber might become a sanitary engineer, or a pipe fitter might become a heating engineer.

ADVANTAGES AND DISADVANTAGES

One advantage is the relatively high demand for the services of plumbers. This trade also enjoys a longer work-year than most other construction trades. The 1951 census reveals that over 73 per cent of all wage-earning plumbers and pipe fitters had a work-year of 50 weeks or more.

Apprenticeship regulations and union organization give a large measure of security. This occupation shares in the benefits of Unemployment Insurance and Workmen's Compensation legislation.

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Against these advantages must be offset the fact that much work must be done in unheated buildings, and in uncomfortable working positions. Heavy articles must often be lifted.

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Plumbers and pipe fitters, like other skilled tradesmen, have their own craft unions. In 1955 over 15,000 journeymen plumbers and pipe fitters were union members. Master plumbers also have their own association with branches in all provinces.

Some tradesmen employed in industrial plants may be members of appropriate industrial unions.

Plumbers and pipe fitters may also belong to unions covering all construction trades. This is especially true in the province of Quebec.

TRENDS

Number in Occupation

The 1951 census revealed that there were nearly 30,000 plumbers and pipe fitters in Canada. They were divided among the different industries as follows:

Primary Industries		792
Mining, Quarrying & Oil Wells	761	
Other	31	
Manufacturing		5,662
Paper Products	1,009	
Transportation Equipment	1,477	
Iron & Steel Products	827	
Products of Petroleum & Coal	478	
Chemical Products	466	
Other	1,405	
Electricity, Gas & Water		799
Construction		18,860
Transportation		603
Trade (Wholesale and Retail)		1,011
Finance		22
Service		1,706
Community	447	
Government	1,054	
Other	205	

Provincial Distribution

Percentage-wise, plumbers and pipe fitters were located in Canada as follows:

	%		%
Newfoundland	1.8	Ontario	37.0
Prince Edward Island	0.4	Manitoba	3.8
Nova Scotia	4.3	Saskatchewan	1.9
New Brunswick	2.2	Alberta	6.3
Quebec	34.0	British Columbia	8.3

Future Outlook

Opportunities for plumbers and pipe fitters will depend, to a large extent, on what happens in the construction industry. In the past ten years, this industry has shown remarkable growth and has

provided many openings for skilled tradesmen. During this time, large numbers of homes, offices and factories have been built and the demand still remains strong. A continuation of this demand will make for good opportunities for plumbers and pipe fitters as well as many other construction workers.

In addition to the impetus given to this trade by new construction work there will be a continuing demand for maintenance and repair work, making this one of the more stable building trades.

New and improved pumping equipment designed for use with shallow or deep wells is creating a demand for modern plumbing facilities in rural and suburban homes. Between 1941 and 1951 the proportion of farm homes having inside running water jumped from 12 to 33 per cent. The implication in terms of demand for installation and repair work is obvious.

It would appear from present indications that prospects for a steady and progressive career in this trade are promising. The plumber and pipe fitter occupies a position of respect in his community and, depending on his own initiative, is able to enjoy a good standard of living.

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LOCAL INFORMATION

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"CANADIAN OCCUPATIONS" SERIES

Monographs and Pamphlets

The monographs listed below, accompanied by pamphlets, except in the case of numbers 12, 13 and 39, have been published to date.

(1) Carpenter
(2) Bricklayers and Stone-Masons
(3) Plasterer
(4) Painter
(5) Plumber, Pipe Fitter and Steam Fitter
(6) Sheet-Metal Worker
(7) Electrician
(8) Machinist and Machine Operators (Metal)
(9) Printing Trades
(10) Motor Vehicle Mechanic
(11) Optometrist
(12) Social Worker
(13) Lawyer
(14) Mining Occupations
(15) Foundry Workers
(16) Technical Occupations in Radio and Electronics
(17) Forge Shop Occupations
(18) Tool and Die Makers
(19) Railway Careers

Careers in Natural Science and Engineering: (20-35, one booklet)

(20) Agricultural Scientist
(21) Architect
(22) Biologist
(23) Chemist
(24) Geologist
(25) Physicist
(26) Aeronautical Engineer
(27) ——
(28) Chemical Engineer
(29) Civil Engineer
(30) Electrical Engineer
(31) Forest Engineer and Forest Scientist
(32) Mechanical Engineer
(33) Metallurgical Engineer
(34) Mining Engineer
(35) Petroleum Engineer

(36) Hospital Workers (Other than Professional)
(37) Draughtsman
(38) Welder
(39) Careers in Home Economics
(40) Occupations in the Aircraft Manufacturing Industry
(41) Careers in Construction

Filmstrips

The Department of Labour has prepared, to date, the following occupational filmstrips in collaboration with the National Film Board. A manual has been prepared as an accompaniment to each filmstrip. These may be purchased from the National Film Board, Box 6100, Montreal, or from any one of its regional offices.

Plumber, Pipe Fitter and Steam Fitter
Careers in the Engineering Profession
The Social Worker
Technical Occupations in Radio and Electronics
Bricklayer and Stone-Mason
Printing Trades
Careers in Natural Science
Careers in Home Economics
Motor Vehicle Mechanic

DEPARTMENT OF LABOUR

Economics and Research Branch

CANADA, 1957

HULL
EDMOND CLOUTIER, C.M.G., O.A., D.S.P.,
QUEEN'S PRINTER AND CONTROLLER OF STATIONERY.

CANADIAN OCCUPATIONS

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PLUMBER, PIPE FITTER and STEAM FITTER

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MONOGRAPH 5
REVISED 1959

DEPARTMENT OF LABOUR, CANADA

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(42) Medical Laboratory Technologist
(43) Careers in Meteorology
(44) Teacher
(45) Physical and Occupational Therapist.

All monographs in the CANADIAN OCCUPATIONS series are priced at 10 cents per copy, with the exception of *Careers in Natural Science and Engineering*, which is 25 cents. A discount of 25 per cent is allowed on quantities of 100 or more of the same title.

Send remittance by cheque or money order, made payable to the Receiver General of Canada to:

The Queen's Printer,

Ottawa, Canada.

CANADIAN OCCUPATIONS

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PLUMBER, PIPE FITTER and STEAM FITTER

MONOGRAPH 5
REVISED 1959

HON. MICHAEL STARR, MINISTER
A. H. BROWN, DEPUTY MINISTER

DEPARTMENT OF LABOUR, CANADA

FOREWORD

During recent years there has been a steadily increasing demand for up-to-date information on occupations.

This demand comes from youth faced with the need of choosing an occupation and of selecting the type of training required; from parents, teachers and other counsellors; from workers shifting to other occupations; from employment service officers; from directors of personnel and union officials, and from other quarters.

This series of monographs and an accompanying series of pamphlets, the latter containing similar information in a condensed form, are attempts to meet this demand. These publications are designed for general use and cover a wide range of occupations, including professions. They indicate, among other things, the nature of the occupation or group of occupations, entrance and training requirements, working conditions and opportunities in each.

The staff of the Occupational Analysis Section has prepared this series with the generous assistance of representatives of management, trade unions and professional associations. The co-operation of the Unemployment Insurance Commission, the Vocational Training Branch of the Department of Labour, and the Dominion Bureau of Statistics is gratefully acknowledged.

Acknowledgement is also made of the assistance obtained from numerous publications on occupations prepared in Canada and in other countries.

DIRECTOR,
Economics and Research Branch,
Department of Labour.

October 1959.

PLUMBER, PIPE FITTER and STEAM FITTER

HISTORY AND IMPORTANCE

The conveyance of water into buildings by means of pipes was a common practice in Roman times. Drinking, bathing and cooling facilities, both private and public, were provided by a system of lead pipes, fed by gravity from aqueducts. Since no power-driven pumps existed until the application of steam in the 18th century to this work, it is not surprising that no progress was made in the centuries between the Roman age and that of steam. England and France, between the 15th and 17th centuries, availed themselves of the gravity supplies obtainable, and such waterworks as those of the New River Company in London were the precursors of modern plumbing.

Since lead (plumbum) was the only material workable for interior piping and the lining of cisterns, with the possible exception of copper, the Roman craftsman dealing with such works was known as a "plumbarius", and the name has been retained in varying forms as that of his modern counterpart.

With the advent of improved steam power, of threaded metal piping of iron and other metals, and an advance in scientific knowledge of the relation of sanitation to epidemics, the 19th century brought rapid advances in water supply and sewage disposal. Indoor water closets became common in England early in that century, and quickly spread to the more advanced European countries; baths became regular equipment for all but the poorest homes in urban areas where a central water supply was installed, and even in some villages.

North America, then largely agricultural and much absorbed in internal expansion, was somewhat behind in these developments; some sections of the population bitterly opposed installation of a bath in the White House, in the 1850's. Hot-water and steam-heating apparatus began to replace stoves and fireplaces in the 1860's. The

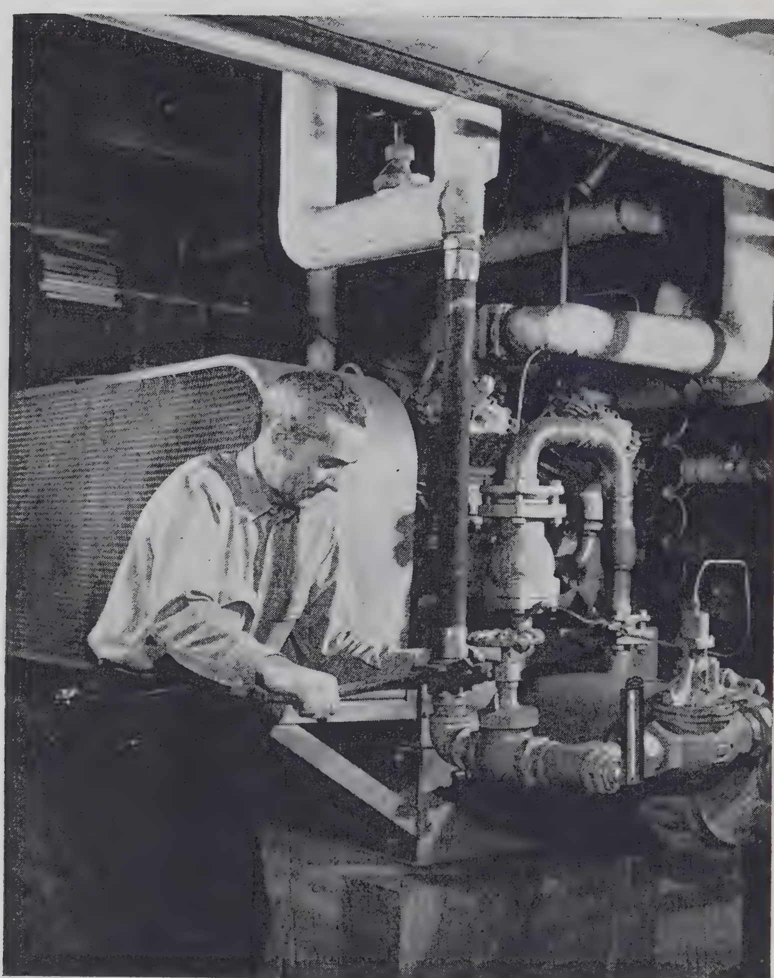

photo: N.F.B.

Installation of air-conditioning equipment — a specialized field

first half of the 20th century saw a tremendous increase in the use of plumbing facilities in homes, offices, hotels, factories and other buildings. New techniques developed as new materials came into use. All this created an increasing demand for the services of plumbers pipe fitters and steam fitters, both in installing and repairing equipment.

Plumbers thus form an important group in the building trades. The high level of construction during the last decade has made heavy demands on the supply of skilled tradesmen for plumbing and heating installation, and there is a need for apprentices in this field.

DUTIES

It is difficult to make a clean-cut separation between plumbers, steam fitters and pipe fitters. It can be stated, however, that there is a separation of functions in large centres to a much greater extent than in smaller ones.

The following is a summary of the duties of plumbers: assembles and installs air, gas, water and waste-disposal systems; cuts openings in walls for pipes; bends, cuts, reams and threads pipes; caulks joints; wipes joints (pours molten solder over joints and spreads and shapes solder with a cloth); tests joints and pipe system for leaks by filling pipe with water under pressure and checking with a gauge for fall in pressure; installs gas, water and sanitary fixtures and equipment with their supports, hangers or foundations.

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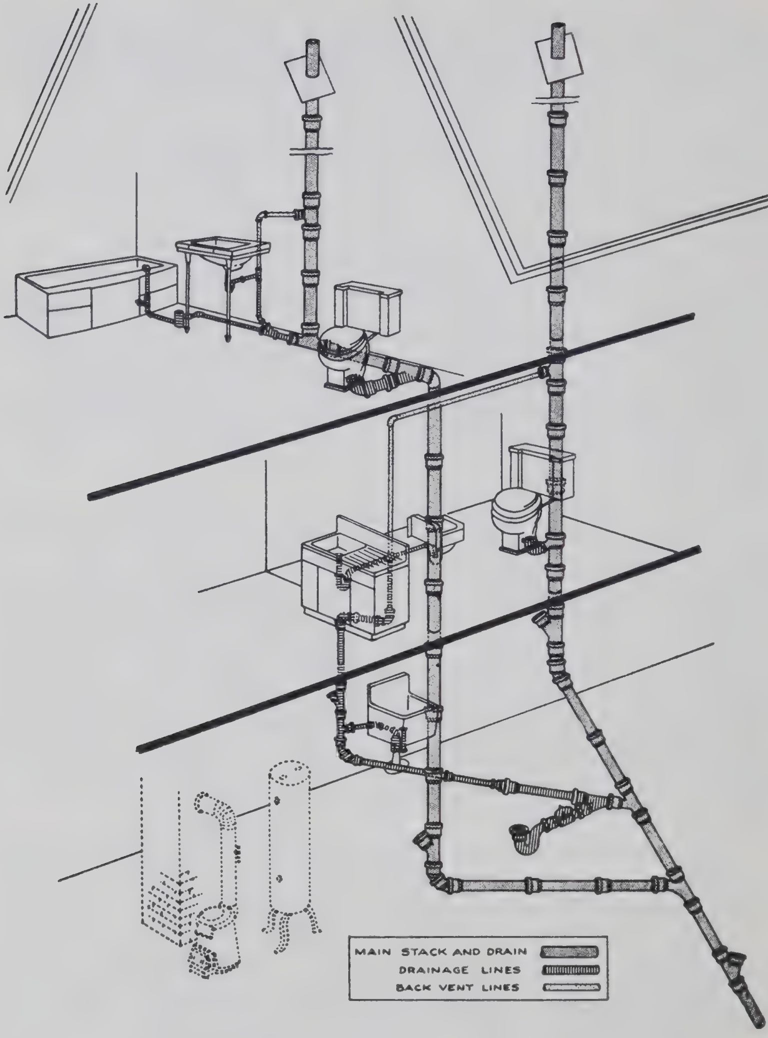

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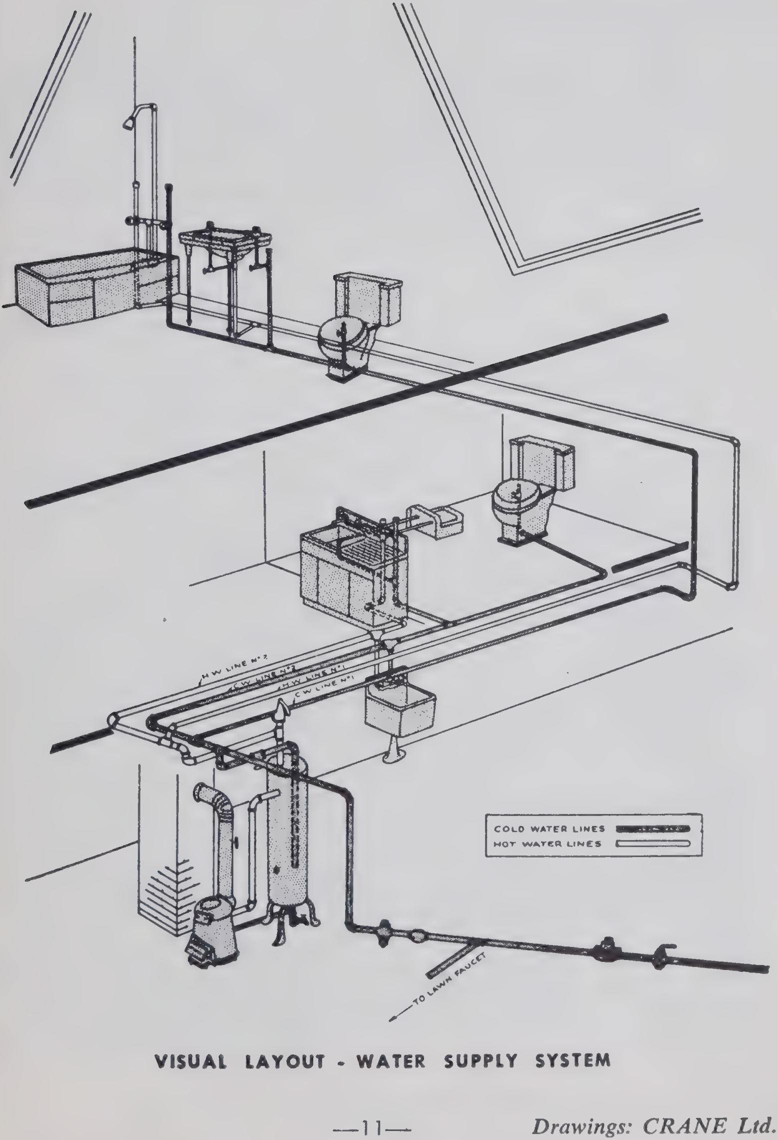

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Drawings: CRANE Ltd.

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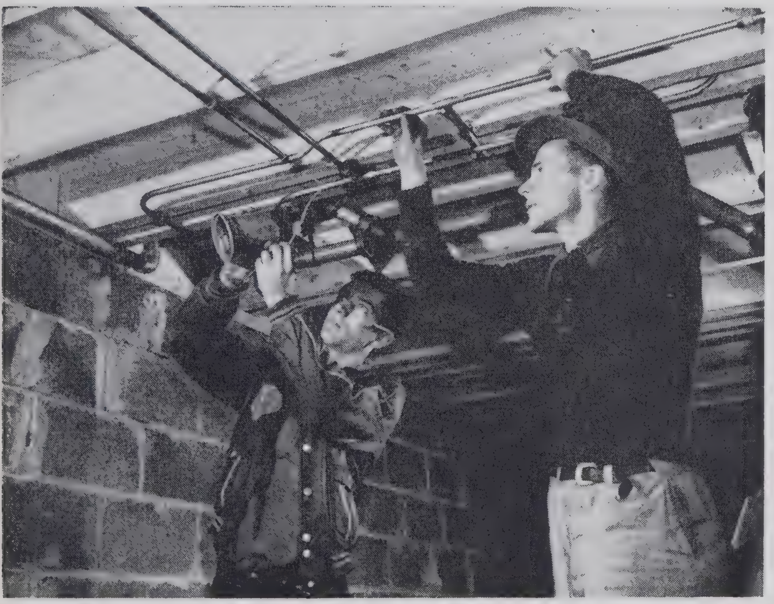

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Plumbers and pipe fitters, like other skilled tradesmen, have their own craft unions. In 1959 over 20,000 journeymen plumbers and pipe fitters were union members. Master plumbers also have their own association with branches in all provinces.

Some tradesmen employed in industrial plants may be members of appropriate industrial unions.

Plumbers and pipe fitters may also belong to unions covering all construction trades. This is especially true in the province of Quebec.

TRENDS

Number in Occupation

The 1951 census revealed that there were nearly 30,000 plumbers and pipe fitters in Canada. They were divided among the different industries as follows:

Primary Industries		792
Mining, Quarrying & Oil Wells	761	
Other	31	
Manufacturing		5,662
Paper Products	1,009	
Transportation Equipment	1,477	
Iron & Steel Products	827	
Products of Petroleum & Coal	478	
Chemical Products	466	
Other	1,405	
Electricity, Gas & Water		799
Construction		18,860
Transportation		603
Trade (Wholesale and Retail)		1,011
Finance		22
Service		1,706
Community	447	
Government	1,054	
Other	205	

Provincial Distribution

Percentage-wise, plumbers and pipe fitters were located in Canada as follows:

	%		%
Newfoundland	1.8	Ontario	37.0
Prince Edward Island	0.4	Manitoba	3.8
Nova Scotia	4.3	Saskatchewan	1.9
New Brunswick	2.2	Alberta	6.3
Quebec	34.0	British Columbia	8.3

Future Outlook

Opportunities for plumbers and pipe fitters will depend, to a large extent, on what happens in the construction industry. In the past ten years, this industry has shown remarkable growth and has

provided many openings for skilled tradesmen. During this time, large numbers of homes, offices and factories have been built and the demand still remains strong. A continuation of this demand will make for good opportunities for plumbers and pipe fitters as well as many other construction workers.

In addition to the impetus given to this trade by new construction work there will be a continuing demand for maintenance and repair work, making this one of the more stable building trades.

New and improved pumping equipment designed for use with shallow or deep wells is creating a demand for modern plumbing facilities in rural and suburban homes. Between 1941 and 1951 the proportion of farm homes having inside running water jumped from 12 to 33 per cent. The implication in terms of demand for installation and repair work is obvious.

It would appear from present indications that prospects for a steady and progressive career in this trade are promising. The plumber and pipe fitter occupies a position of respect in his community and, depending on his own initiative, is able to enjoy a good standard of living.

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LOCAL INFORMATION

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CANADIAN OCCUPATIONS FILMSTRIPS

The Department of Labour has prepared, to date, the following occupational filmstrips in collaboration with the National Film Board. A manual has been prepared as an accompaniment to each filmstrip. These may be purchased from the National Film Board, Box 6100, Montreal, or from any one of its regional offices.

Plumber, Pipefitter and Steamfitter
Careers in the Engineering Profession
The Social Worker
Technical Occupations in Radio and Electronics
Bricklayer and Stone-Mason
Printing Trades
Careers in Natural Science
Careers in Home Economics
Motor Vehicle Mechanic
Mining Occupations
Draughtsman
Careers in Construction
Sheet Metal Workers
Machine Shop Occupations
Careers in Meteorology
Medical Laboratory Technologist (in colour)
Teacher (in colour)

DEPARTMENT OF LABOUR

Economics and Research Branch

CANADA, 1959

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OTTAWA
QUEEN'S PRINTER AND CONTROLLER OF STATIONERY

CANADIAN OCCUPATIONS

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SHEET-METAL WORKER

★

MONOGRAPH 6

DEPARTMENT OF LABOUR, OTTAWA

CANADIAN OCCUPATIONS

★

SHEET-METAL WORKER

MONOGRAPH 6

HON. HUMPHREY MITCHELL, MINISTER
ARTHUR MacNAMARA, C.M.G. LL.D., DEPUTY MINISTER

DEPARTMENT OF LABOUR, OTTAWA

FOREWORD

During recent years there has been a steadily increasing demand for up-to-date information on occupations.

This demand comes from youth faced with the need of choosing an occupation and of selecting the type of training required; from parents, teachers and other counsellors; from workers shifting to other occupations; from employment service officers; from directors of personnel and union officials, and from other quarters.

This series of monographs and an accompanying series of pamphlets, the latter containing similar information in a condensed form, are attempts to meet this demand.

These publications represent an expansion of an earlier series issued by the Department of Veterans Affairs to assist members of the armed forces returning to civilian life following the end of the war. These current series, designed for general use, cover a wide range of occupations, including professions. They indicate, among other things, the nature of the occupation or group of occupations, entrance and training requirements, working conditions and opportunities in each.

The monographs have been prepared by our research staff working on occupations, with the generous help and advice of officials of the Unemployment Insurance Commission, Vocational Training Branch and Bureau of Technical Personnel of the Department of Labour, Dominion Bureau of Statistics, Provincial Departments of Education and of Labour, employers' associations, trade unions, professional associations, and other government and non-government bodies.

Grateful acknowledgment is made of this assistance and that obtained from numerous publications on occupations prepared in Canada and in other countries.

DIRECTOR,
Economics and Research Branch,
Department of Labour.

July, 1949.

SHEET-METAL WORKER

HISTORY AND IMPORTANCE

Tin and copper were among the earliest metals to be used by man. This was reasonable enough, since they are highly malleable, and could be combined in a hard alloy, bronze. Tinsmiths and coppersmiths have been making vessels for domestic use since before the dawn of history, and armour and plates of bronze also grew beneath their hammers. Much of their work was highly decorative. The use of iron as a sheet metal owes its origin to the need for armour, but it was not until the invention of the rolling-mill in the 17th century that extensive sheet-metal work was possible. The tinsmith and the coppersmith had carried on meantime. The production of thin sheets of iron was much cheaper than that of heavy castings, and many articles, such as stoves and stove-pipes, could be made in whole or in part from this sheet material instead of from solid metal. The tendency of iron to oxidize in the air led to its being coated with tin or with zinc, sometimes with copper, later with a mixture of lead and tin. The sheets thus covered could be cut with shears, hammered into the required shape, stamped with dies, easily bored for rivets or bolts, and had the advantage of lightness and relatively cheap replacement cost. For mass production sheet-metal parts could be mechanically cut or pressed, and the introduction of automobiles and other heavy items led to a demand for a heavier sheet which could still be workable. A somewhat heavier gauge had already been in use for the roofing and siding of buildings, and was for some years used even on walls and ceilings. Zinc-coated sheet-iron had also been in use for rain gutters and pipes, pails, bins and other containers, and even for roofing and for walls.

In manufacturing, most modern sheet-metal parts are mechanically stamped or cut; their assembly, their adjustment to fit buildings, their installation and their repair still require skilled workers. The use of aluminium and magnesium alloys in sheets has necessitated, in recent years, new techniques. Welding has largely replaced soldering and riveting.

Photo N.F.B.

Sheet-metal instruction in a vocational school

FIELD OF WORK

A number of these workers operate on their own account, as repairmen on furnaces, roofs, air-conditioning equipment, and occasionally still on domestic utensils. Many manufacture on a small scale rain and fume pipes, eave-troughs, stove-pipes, and related articles in common demand which must often be made to order.

The automobile and aeroplane industries employ many workers in assembly work. These have been included in census figures as "sheet-metal workers".

The construction industry requires sheet-metal workers for making and placing the necessary flashings around chimneys and valleys, for eave-trough work, for making spouting and conveyors in elevators, air-conditioning and exhaust ventilation systems, and occasionally still for all-metal roofing, either with full sheets of various metals, or with sheet-metal shingles. A few buildings have metal siding, ceilings and inside walls. Sheets of aluminium alloys are being used more extensively.

Boat-building, increasingly with aluminium alloys, is also a field employing sheet-metal workers. Shipbuilding also provides employment for some.

Steam railways and electric transportation need sheet-metal workers for construction and maintenance.

Metal furniture, toy-making, domestic hardware, and air-conditioning are among other industries using some sheet-metal workers.

DUTIES

Skilled sheet-metal workers, with the aid of blueprint or specifications to mark the lay-out of the job, fabricate, assemble, alter, repair and install their own patterns of sheet-metal articles and equipment; cut metal with hand or mechanical shears; shape it (mostly using a machine), punch or drill holes for rivets, bolts, screws, using centre punch and hammer, assemble sheet-metal parts with necessary brackets and hangers; bolt, rivet and fit them into units for erection; make attach-

ments, seams and joints by welding, riveting, bolting, soldering, nailing, or fastening with metal ties or wood screws. In factory work they may be designated according to the operation performed.

A special tradesman in this group is the furnace repair sheet-metal worker, who lays out, cuts, shapes, crimps, folds, fits and installs sheet-metal furnace casings and pipes as replacement parts or as a new installation.

Many establishments employ a sheet-metal maintenance man to do all necessary repairs to appropriate fittings and equipment.

Sheet-metal workers in the aircraft industry are actually assembly men operating machines. Their duties consist chiefly in the cutting and forming of parts. They are usually given a job designation, such as "sheet-metal former".

The term "sheet-metal worker" is also a general one applied to those engaged in the fabrication of sheet-metal used in the assembly of automotive parts. They are more specifically designated according to the machine or part on which they work.[1]

A fully skilled tradesman should be able to use hand tools to lay out, cut, fit, assemble or repair sheet-metal parts, patterns or models, read blue-prints, and use a variety of shop machines, and have a considerable knowledge of draughting. Technical knowledge is essential.

QUALIFICATIONS

In common with other skilled trades, this craft prefers its apprentices to be minors (in British Columbia they may be admitted at 15), with 21 as a top limit in several provinces. Secondary or technical school education for at least two years is most desirable, and courses in mathematics and draughting are an advantage. In Manitoba and Alberta Grade IX is the educational standard required.

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[1] The United States Dictionary of Occupational Titles separates this group under "Sheet-Metal Worker I".

Good health, a reasonably sturdy physique, steady and well co-ordinated muscular control, strong hands and forearms, the ability to stand while working, to read and translate blue-prints, and to co-operate with other workers are essential. Nervous stability, honesty and a sense of responsibility, are all necessary.

Since many sheet-metal workers operate on their own account, ability to meet people, make estimates, work from verbal instructions, handle workers, and keep accounts will be requisite in one who aims at having his own business.

TRAINING

This is a "designated" trade for apprenticeship in almost all provinces. In certain areas of Quebec it comes under local Apprenticeship Commissions, notably that of the building trades in Montreal. The Drummondville Centre d'Initiation Artisanale has a 50-week course, and the Ecole des Arts et Metiers, Lauzon, a 52-week one. The Octave Casgrain Arts and Crafts School, Montreal, (bilingual), provides a complete theoretical and practical course for two years of 10 months each.

In provinces having apprenticeship regulations, four years is the usual period of service. In Alberta, Manitoba and British Columbia, it is five years. Credits have been allowed for Canadian Vocational Training graduation or for similar technical courses in this trade, usually assessed in each case individually. Veterans have been given special consideration. The apprenticeship period usually includes several weeks a year of classroom work, and some provinces have a three to six-month probationary period before apprenticeship. Credit is given for this period when the proper indenture has been executed.

ENTRY INTO OCCUPATION

Contact for apprenticeship, or "training-on-the-job" where apprenticeship is not mandatory, may be arranged through the Youth Section of the National Employment Service.

EARNINGS

Apprentice rates are based on a varying percentage of those for journeyman, rising in each year. This percentage varies from 25 to 50 per cent in the first six months' period, rising annually or, in some provinces, semi-annually by 10 or 5 per cent of the journeyman rate, to a maximum in the last period of apprenticeship varying from 70 to 95 per cent.

Journeymen's rates vary considerably. It is not possible to make a separation between the skilled craftsman's rates of pay and that of the semi-skilled factory worker. In giving the following figures, they should be regarded in the light of the nature of the industry in each locality employing persons classified as sheet-metal workers, and of the actual degree of skill involved in their work.

The following are November, 1948, figures for hourly rates in certain cities:

Charlottetown	$0.75	London	$1.10
Halifax	1.10	Fort William	1.10
Saint John	0.90	Winnipeg	0.95
Quebec	1.00	Regina	1.20
Montreal	1.25	Calgary	1.40
Ottawa	1.40	Edmonton	1.45
Toronto	1.65	Vancouver	1.65
Hamilton	1.13	Victoria	1.43

Earnings of "own account" workers are not ascertainable.

ADVANCEMENT

The general line of promotion is from apprentice to journeyman, journeyman to foreman or to operating on own account.

RELATED OCCUPATIONS

Boiler-makers, roofers, metal pattern-makers, template-makers, light structural metal-workers, and some workers in plexiglass and other plastic assembly, follow occupations related in some aspect to sheet-metal work.

ADVANTAGES AND DISADVANTAGES

This trade will appeal to those who like to do skilled hand work. The rates of pay compare well with those of other skilled trades, and the nature of the work is such that it is little affected by seasonal conditions. There appears to be, with the increased use of the lighter metals in sheet form, an expanding field for this work. This occupation shares in the benefits of Unemployment Insurance and Workmen's Compensation legislation.

Work may be under conditions of heat, cold, or wet. There are minor hazards associated with cutting tools and sharp metal edges, as well as with work on ladders or on roofs. There is considerable noise associated with this work.

ORGANIZATIONS

As workers in this trade are employed in widely diversified industries, there is no separate union covering all its members. The various metal trade organizations, such as automotive, include the semi-skilled sheet-metal workers employed in the respective industries. Those engaged in the construction industry are provided for by craft unions.

TRENDS[1]

Number in the Occupation

In considering the figures below, it must be remembered that many factory workers calling themselves sheet-metal workers are only semi-skilled at best. The 1941 census records approximately 11,000 males, of whom about 900 were on active service, and 400 females engaged in this work. The number is likely to be considerably higher today, with the expansion of the construction, automotive and electrical products fields, even though there has been a decrease in aircraft manufacture. It is probable, nevertheless, that the actual number of fully skilled craftsmen does not exceed 2,000.

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[1] For general statistical information on, and a discussion of, trends in the construction and other industries employing sheet-metal workers, the reader is referred to Part I of Monograph 1, "Carpenter".

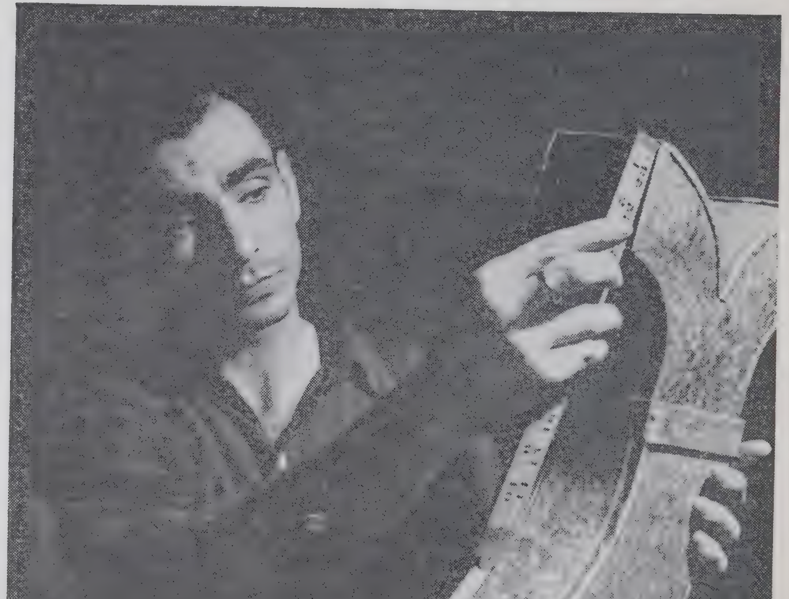

Photo N.F.B.

Checking an air-conditioning duct

Geographical Distribution

Of the males in this occupation, approximately 500 were in the Maritimes, 2,700 in Quebec, 5,200 in Ontario, 1,600 in the Prairie region, and 900 in British Columbia, at the time of the census.

Industrial Distribution

The major industries employing sheet-metal workers in 1941 were:

Sheet-metal products	**3,870**	
Aircraft	**1,440**	
Construction	**1,400**	**(all skilled)**
Foundry products	**660**	
Primary iron	**360**	
Electrical products	**280**	
Automotive, etc.	**270**	
Ship-building	**210**	**(all skilled)**

1,041 were recorded as on "own account".

The remainder were distributed over a wide variety of industries. Most of the women were unskilled workers in the electrical products group.

Growth

The only figures available are the census data for 1931 and 1941, which show an increase from approximately 7,500 males to 11,000, or almost 45 per cent. This is about four times the rate of population increase in this period. Again, caution should be used in interpreting the 1941 figures in terms of skilled craftsmen.

Present Demand and Supply

The National Employment Service figures in the Autumn of 1948 indicate three times as many job vacancies as applicants in this trade, (e.g. 362 vacancies, 112 applicants). More than half the vacancies were in Ontario. There was a small surplus of applicants in the Pacific region. This ratio of unfilled vacancies to applicants was slightly higher than it was at the same date in 1947.

At the end of July, 1949, there was some falling off in demand. Vacancies reported were 130, applicants 210. Ontario and the Prairie region still showed an excess of vacancies.

Future Prospects

The greatly enlarged use of air-conditioning, and the extensive construction programmes of the post-war period have considerably increased the demand for sheet-metal workers. It is impossible to foretell what may happen to affect this demand one way or the other, but changes in the output of the aircraft or shipbuilding industries, and modifications in the extent and nature of construction, will obviously affect employment opportunities in this trade.

The short-term outlook for the skilled journeyman may be termed definitely favourable. Apprenticeship regulations in most provinces will be a safeguard against overcrowding. During recent years the annual intake to the trade has been approximately 500 for all Canada; many of these have entered the trade following Canadian Vocational Training courses.

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Canadian Construction Association, Ottawa Electric Building, Sparks St., Ottawa; *Apprenticeship in the Building Trades in the Province of Quebec* (June, 1949). A very comprehensive and informative report on a recent survey.

AUDIO-VISUAL MATERIAL

Readers desiring information on film sources, available material, and the organization of local film libraries may obtain it from the National Film Board offices listed in Monograph 1, "Carpenter".

LOCAL INFORMATION

LOCAL INFORMATION

LOCAL INFORMATION

LOCAL INFORMATION

CANADIAN OCCUPATIONS

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ELECTRICIAN

MONOGRAPH 7

HON. HUMPHREY MITCHELL, MINISTER
ARTHUR MACNAMARA, C.M.G., LL.D., DEPUTY MINISTER

DEPARTMENT OF LABOUR, OTTAWA

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DIRECTOR,
Economics and Research Branch,
Department of Labour.

July, 1949.

ELECTRICIAN

HISTORY AND IMPORTANCE

Although static electricity, induced by friction, was discovered by the Greek philosopher Thales some 2,500 years ago, and magnetism was long a curiosity whose only application was the mariner's compass, the practical uses of these forces were virtually unknown until little over a century ago.

In the 18th century the Italian scientist Volta gave impetus to the practical development of electricity when he successfully constructed the electric wet-cell battery — the first practical electric power source. The discovery by Faraday in 1831 of the principle that a voltage could be induced in a coil by continually changing a magnetic field about the coil opened the way for the development of the dynamo or generator. The invention and development of the electric telegraph was the first application of electricity and magnetism used together. The telephone, several decades later, used the same two forces.

The harnessing of water and steam power to drive the dynamo presented a new source of power which made for great and rapid change in industry and enhanced the living conditions of mankind. Of significance was the discovery of the transformer, by means of which generated voltages could be stepped up or down. The transformer and wire conductors made of low-resistance copper made possible the transmission of high voltages over great distances, thus making power available at retransformed workable low voltages to homes and industries distant from the source.

With a source of current now available, it was not long before the electric arc lamp came into wide use for street illumination. Next was invented a lamp which, using a

resistant filament, heated by electric current, in an enclosed glass bulb free of oxygen, avoided the noise and replacement of carbons necessary in the arc light. Thus electric light became possible for all illuminating purposes wherever a power source was available.

Another application of electric power which has revolutionized modern life is the electric motor, which, connected with a source of current, operates a wide variety of domestic, agricultural, manufacturing, mining and service appliances.

The internal combustion engine, now an everyday feature in almost all inhabited parts of the world, depends on a magneto, or more generally a generator with a storage battery, for its ignition; the bodies it propels draw on the same source for lights and other adjuncts.

The heat generated by the resistance of certain materials to an electric current has wide uses now, notably for warming rooms and for cooking.

The development of generators and transmission, and of apparatus so numerous and varied, necessitated the parallel development of craftsmen specializing in the manufacture, installation, maintenance and repair of these. These are the men now known as electricians.

The term "Electrician" is often rather vaguely used, and it is desirable therefore to define clearly the scope of any treatise on this trade. This monograph, therefore, *includes* Construction Electricians, Stage and Motion Picture Electricians, Ship Electricians, Power-House Electricians, Electricians (aircraft) and Electricians (automotive). These correspond with the classifications included under the Dominion Bureau of Statistics Census heading "Electricians and Wiremen", and are all skilled craftsmen.

It *excludes* Electrical Appliance Repairmen and Radio Repairmen, as well as Refrigeration Mechanics, Linemen and Cablemen (transportation and communication), and semi-skilled bench workers in factories.

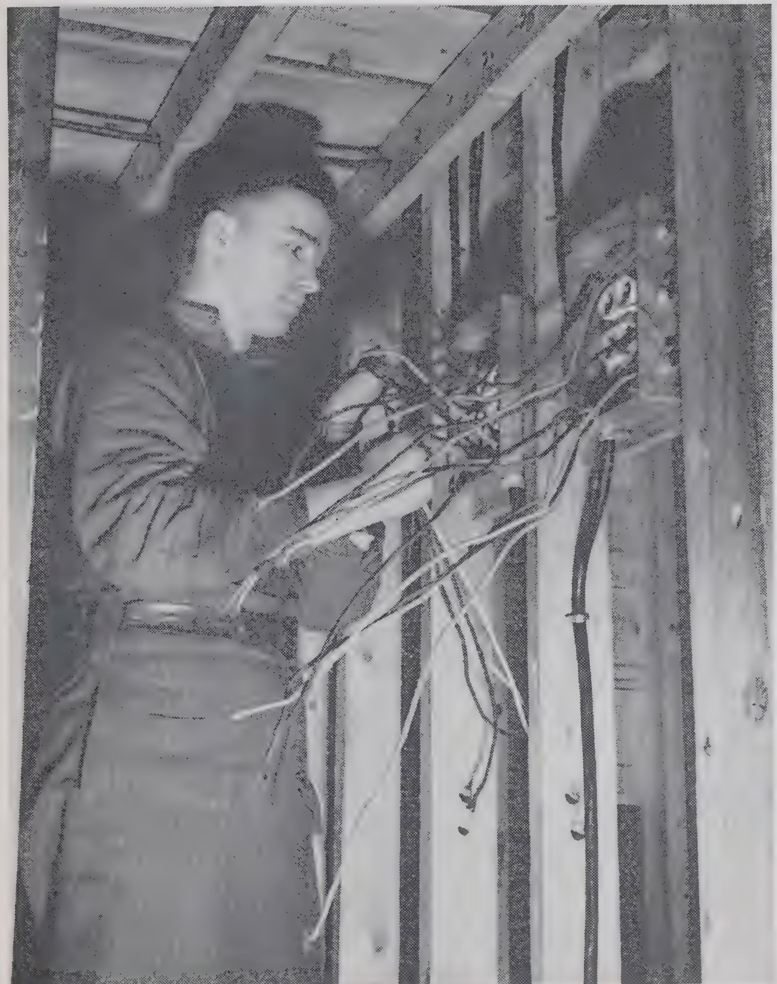

Photo N.F.B.

Wiring a house

DUTIES

The definition of Electrician (any industry) in the United States Dictionary of Occupational Titles covers the major field of duties, as follows:

"Lays out, assembles, installs, and tests electrical fixtures, apparatus, control equipment, and wiring used in the alarm, radio, communication, light and power systems of buildings or other construction projects: plans proposed installations from blue-prints, sketches or specifications; secures panel boards, switch boxes, pull boxes and other concealed or recessed equipment to the frame of the structure prior to erection of walls, the plastering of rooms, or pouring of concrete; measures, cuts, threads, bends, assembles and installs conduit which connects the various outlets, panels and boxes, using tools such as hacksaw, pipe benders and threading tool; draws wires through conduit; splices wires by removing insulation from conductors, scraping conductors clean with a knife or cutting pliers, twisting conductors together, soldering the connection, and applying several layers of friction tape; installs and connects equipment to wiring system; tests circuits for continuity and proper connections, using a battery and buzzer or light bulb."

An *aircraft electrician* performs similar duties as applied to aircraft fixtures; an *automotive electrician* installs and also repairs and adjusts the electrical apparatus on automotive vehicles; a *power-house electrician* repairs and maintains equipment, including generators. A *ship electrician* installs motors, generators, electric pumps, refrigeration machinery, laundry machinery, blowers, clocks, bells, telephones, etc., as well as all wiring; he also repairs equipment. A *stage electrician* sets up and also operates stage electrical equipment.

Other titles, covering partial duties of "Electrician (any industry)," sometimes with some specialized apparatus, are given in the Dictionary of Occupational Titles.

Widely speaking, the duties of any electrician will vary according to the industry in which he is engaged, and can be outlined as the installation, maintenance and repair of electrical apparatus of any kind.

QUALIFICATIONS

Generally speaking, the age limits for apprenticeship in this occupation are from 16 to 21. Educational standards vary: Grade 8 is specified in Ontario, Grade 9 in Manitoba, Grade 10 in Alberta, Grade 11 in New Brunswick; other provinces do not stipulate any grade. Age and educational standards are not rigid; special consideration is given to those who are over the age limit and to those with less education. Mathematics and physics are desirable; draughting is an asset.

Good health and eyesight, dexterous hands, average strength, agility, honesty, tact and ability to study are all necessary.

TRAINING

In almost all provinces this is a trade designated for apprenticeship, and requires a licence before it can be practised as a journeyman. It is one of the two trades in Quebec so regulated for the entire province; "shop" electricians are not covered in Ontario and Nova Scotia.

The length of apprenticeship is generally four years; in New Brunswick, Manitoba, and for "shop" electricians in British Columbia, it is five years. Formal instruction is included for several weeks annually in most provinces. A probationary period, usually three months (in New Brunswick six) is required.

Courses which were given by Canadian Vocational Training for veterans, lasting six months, are usually assessed as being equivalent to two years of apprenticeship. Similar pre-employment training for civilians is now authorized, subject to provincial agreement.

Most provinces give a trade test before licensing an apprentice as a journeyman. Some municipalities also require the passing of an examination before the trade can be practised locally.

ENTERING OCCUPATION

Since a ratio of apprentices to journeymen is controlled by Apprenticeship Boards consulting union locals and employers, it is advisable to consult union officials as to the possibility of entrance. The Youth Section of National Employment Service offices is available to assist young people in making the necessary contacts.

In this connection it must be noted that, perhaps as a result of the number of veterans making this trade their choice for training, the saturation point of immediate intake may have been reached in some areas. As early as November, 1945, the Directors of Apprenticeship for Saskatchewan, Alberta, Manitoba, Ontario, Quebec and New Brunswick considered this point was being approached. In Saskatchewan and Alberta an actual shortage of journeymen was stated to be the reason for inability to take in apprentices. It is not clear that this condition could be remedied except over a period of several years.

In most building trades the unions have waived their ratios in favour of veterans, but there is a practical limit to the extent to which this can be done when the available journeymen who would have to train the apprentices are themselves engaged in urgent jobs.

EARNINGS

The rates of pay for journeymen are fixed by local agreement between union and employer. The following are some representative recent hourly wage rates:

Charlottetown	$0.85	London	$1.45
Halifax	1.30	Windsor, Ontario	1.65
Saint John	1.10	Fort William	1.35
Quebec	1.00	Winnipeg	1.35
Montreal	1.35	Regina	1.40
Ottawa	1.20	Calgary	1.50
Toronto	1.65	Edmonton	1.50
		Vancouver	1.70

Apprentice rates are based on a percentage of those for journeymen, rising usually to 75 per cent or 80 per cent in the last year. They vary locally. Increases are semi-annual except in Quebec, Ontario and Saskatchewan, where they are annual.

The most recent record of annual income covers 1941, and shows a figure averaging considerably higher than that of most skilled tradesmen at that time. This work was then the least seasonal in the "construction occupations" group.

Changes in planning may narrow any differential between the employment period of electricians in the construction industry and that of others in the trade.

ADVANCEMENT

The apprentice, whose wages increase at regular intervals, advances to journeyman. A journeyman can become a foreman, or contractor on own account.

RELATED OCCUPATIONS

There are many occupations in the electrical field into which the electrician, because of his acquired skills and knowledge, can enter either directly or with some further training. Some of these are as follows:

Power Station

Operator, lineman, meterman, inspector.

Telephone and Telegraph

Lineman, installer, cable-splicer, troubleman, repairman.

Manufacture of Electrical Equipment

Assemblyman, inspector or tester, serviceman.

Radio

Operator, repairman.

Miscellaneous

Air-conditioning and refrigeration mechanic, electrical appliance repairman, electrical goods salesman.

With some years of study, including a university course, experience as an electrician may lead to the profession of electrical engineer.

ADVANTAGES AND DISADVANTAGES

In this trade one has the satisfaction of seeing the results of his work put to continuous and useful service.

It is also one where there is a wide field to be studied and learned.

Earnings and employment compare favourably with those of some trades requiring equally long training. Union regulations and provincial legislation prevent the competition of semi-skilled persons. Work may be indoors or outdoors, and on a considerable variety of jobs. The cost of a tool kit is reasonable, and the capital required to set up on one's own account is not great. This trade shares in the benefits provided by Workmen's Compensation and Unemployment Insurance legislation.

There are no marked disadvantages in this trade. The occupational hazards include those common to all who use ladders and scaffolding; cuts from wires or tools are possible, and carelessness may lead to electric shock or burns. Some of the work must be done in a stooping or recumbent position.

ORGANIZATIONS

Some electricians may belong to the general construction trade unions; the majority are members of one of three major organizations of electrical workers.

In some industries membership in the appropriate industrial union may be held.

TRENDS[1]

Number in Trade

In 1941, according to the Dominion Bureau of Statistics, there were over 22,000 (excluding some 2,100 on active service) electricians and wiremen gainfully occupied as such in Canada.

Of the 22,000 gainfully occupied, 20,000 were wage earners, 1,800 were working on "own account" and 200 were employers.

In 1941, the number of electricians and wiremen who were in the construction industry formed only 25 per cent of the total. The National Joint Conference of the Construction Industry estimated, in February 1946, that there were then 7,200 electricians engaged in that industry, or 7.2 per cent of all construction tradesmen.

Age Distribution

There is a smaller proportion of electricians in the age group 55 and over than in any other construction trade. In 1941, the proportion was 10 per cent, compared with a 25.5 per cent average for the whole construction group. The comparatively recent origin of this trade probably accounts for this disparity. The proportion of electricians in the age groups 24 and under, and 25 to 54, (16.6 per cent and 73.4 per cent, respectively) is higher than that of any other construction trade. In view of the foregoing, fewer openings because of retirements can be expected during the next few years in this occupation than in the other trades.

Regional Distribution

Available statistics indicate that the distribution of electricians is not dependent on population so much as on location of industries, and powerline facilities. In 1941, Quebec and Ontario together had 77 per cent of all electricians and wiremen. The distribution in the other

[1] For general statistical information on, and a discussion of, trends in the construction and other industries employing electricians, the reader is referred to Part I of Monograph 1, "Carpenter".

regions was: Maritimes 6 per cent; Prairies 9 per cent; British Columbia 8 per cent. The urban nature of this occupation is evident from the fact that, in 1941, 36 per cent of all electricians were located in the eight largest cities, which accounted for 29 per cent of the population. The degree of concentration in cities is greater in the case of electricians and wiremen in the construction industry. A compilation of manpower in 1942 shows that seven of the largest urban centres, with only 26 per cent of the total population, accounted for 46 per cent of all construction electricians. The concentration of these tradesmen in the urban areas is to be expected, since it has been estimated that most of the 40 per cent of Canadian families who are without electricity are in the farming districts, due in large part to inadequate powerline facilities in these rural areas. The percentage distribution of construction electricians by provinces for the year 1942 is as follows: P.E.I., 0.3; N.S., 6.0; N.B., 1.9; Que., 40.0; Ont., 36.3; Man., 3.1; Sask., 1.7; Alta., 3.5; B.C., 7.0.

Industrial Distribution

The skills of the electrician are used in many industries. 75 per cent of the total number in this trade were employed outside the construction industry. This compares with an average of 17.3 per cent for the major "construction trades". Consequently the electricians were much less vulnerable to former depressed conditions in the construction industry than other tradesmen. In 1941, electricians were distributed by industry as follows:

		Per Cent
Mining, Quarrying, Oil Wells		**4.0**
Manufacturing		**55.0**
Iron and its products	**15.0**	
Non-ferrous metal products (including 14% in Electrical products and repair)	**16.5**	
Electric Light and Power	**15.0**	
Other Manufacturing	**8.5**	
Construction		**25.0**
Transportation and Communication		**7.0**
Trade, Wholesale and Retail		**3.0**
Service (Public and Other)		**4.0**
Other industries		**2.0**

Growth

Between 1921 and 1941, the number of electricians and wiremen gainfully employed in Canada rose from 13,000 to over 24,000 (including those on active service), representing an increase of about 90 per cent for the twenty-year period or an average annual increase of 4.5 per cent. The average annual growth was more rapid in the first decade of this period than in the second (7.7 per cent as compared with 1.3 per cent) and reflects the economic ups and downs in the construction and manufacturing industries. It compares with a population increase averaging 1.8 per cent in the former decade and 1.1 per cent in the latter.

A comparison of the distribution by industry of electricians and wiremen for the years 1931 and 1941 reveals a widening field of employment. Although the number in the construction industry fell from 6,650 in 1931 to 5,630 in 1941, a decline of 15 per cent, the number in the manufacture of iron and its products increased from 1,700 to 3,270, a rise of 90 per cent; in the non-ferrous metal products industry there was a 44 per cent increase over 1931, including an increase of 40 per cent in electrical products and repair. It is interesting to note that the proportion of electricians and wiremen in the construction industry to the total decreased from 60 per cent in 1921 to 25 per cent in 1941. A comparison of the industrial distribution of electricians and wiremen for the years 1931 and 1941 is given in the following table for certain industries:

	1931	1941
Construction Industry	6,650	5,630
Iron and its products	1,700	3,270
Non-ferrous metal products (including Elect. products and repair)	2,530	3,650
Electric light and power	3,490	3,280
Transportation and communication	2,180	1,560

These changes must be considered in the light of the abnormal conditions existing in 1941. War-time manufacturing in the metal industries was beginning to get under way then; construction was largely limited to building for emergency industry and for the armed forces.

Electric street railways were being replaced by buses to a marked extent, while the "radial" electric lines in Central Ontario had almost all been eliminated by highway competition. The light and power field, which shows a small decrease in employment, had been static for a decade, owing to the lower demand for industrial power during the 1930's.

Present Labour Demand and Supply

The July, 1949 figures of the National Employment Service indicate some falling off in employment, the total vacancies registered being only 70, and the applicants numbering 785. The Prairie region had a relatively small surplus of applicants; the Maritimes showed 107, Quebec 292, Ontario 148, and the Pacific region 145. It must be considered, however, that some vacancies are filled without entering into the records quoted.

Future Employment Prospects

An increasing volume of electrical supplies seems likely to help safeguard the employment of many electricians in the construction industry for the next few years, since the programme of building activity will probably spread the demand over a longer period than might have been expected, while at the same time not encouraging a surplus of apprentices such as might have obtained had demand remained critically high.

Heavy industry, at present increasingly active as metal supplies become available, may reach its peak before long, and the future demand here will depend on the general factors detailed in Part I of Monograph 1, "Carpenter," as well as the special factors set forth below:

(*a*) The construction in Central Canada and, to a lesser extent, in all regions, of new electric power plants will create an increasing demand for electricians in the electric light and power field and in the construction and manufacturing fields also, as it makes more power available and extends its use to new areas. The extension of electrical power to rural communities and areas will have a favourable effect on employment. The St. Lawrence

development, if and when put into effect, would have a major influence in this connection, directly as well as through heavy industry; the new Ottawa Valley power plants and the Bridge River power project in British Columbia, are also important.

(*b*) The importance of heavy industry to this trade makes the export demand for products of such industry a vital factor in employment. This applies especially to the electrical apparatus, automotive and machinery branches. Consumer's resistance to prices of durable consumer goods both at home and abroad would cause a drop in employment in this field.

(*c*) The replacement of water-power and steam-power by electricity is still going on. Besides, the electric motor is being used increasingly for small tools and machines formerly hand or foot operated, both in the factory and in the home.

(*d*) Discovery and development of iron and copper deposits which can be economically processed may have a major effect on Canadian heavy manufacturing.

Conclusion

The future of the electrician's trade in Canada is bound up with that of the heavy metal, electric power, and construction industries.

Apprenticeship and unionization have provided protection against semi-skilled competition. The demand for apprentices is a limited one, and enquiries should be made of the local union.

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AUDIO-VISUAL MATERIAL

Readers desiring information on film sources, other available material, and the organization of local film services may obtain it from the National Film Board offices listed in Monograph 1, "Carpenter".

LOCAL INFORMATION

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DEPARTMENT OF LABOUR

Economics and Research Branch

OTTAWA, 1949

OTTAWA
EDMOND CLOUTIER, C.M.G., B.A., L.PH.,
KING'S PRINTER AND CONTROLLER OF STATIONERY,
1949

CANADIAN OCCUPATIONS

★

MACHINIST and MACHINE OPERATORS (Metal)

★

MONOGRAPH 8

DEPARTMENT OF LABOUR, OTTAWA

CANADIAN OCCUPATIONS

★

MACHINIST and MACHINE OPERATORS (Metal)

MONOGRAPH 8

HON. HUMPHREY MITCHELL, MINISTER
ARTHUR MACNAMARA, C.M.G., LL.D., DEPUTY MINISTER

DEPARTMENT OF LABOUR, OTTAWA

45

FOREWORD

During recent years there has been a steadily increasing demand for up-to-date information on occupations.

This demand comes from youth faced with the need of choosing an occupation and of selecting the type of training required; from parents, teachers and other counsellors; from workers shifting to other occupations; from employment service officers; from directors of personnel and union officials, and from other quarters.

This series of monographs and an accompanying series of pamphlets, the latter containing similar information in a condensed form, are attempts to meet this demand.

These publications represent an expansion of an earlier series issued by the Department of Veterans Affairs to assist members of the armed forces returning to civilian life following the end of the war. These current series, designed for general use, cover a wide range of occupations, including professions. They indicate, among other things, the nature of the occupation or group of occupations, entrance and training requirements, working conditions and opportunities in each.

The monographs have been prepared by our research staff working on occupations, with the generous help and advice of officials of the Unemployment Insurance Commission, Vocational Training Branch and Bureau of Technical Personnel of the Department of Labour, Dominion Bureau of Statistics, Provincial Departments of Education and of Labour, employers' associations, trade unions, professional associations, and other government and non-government bodies.

Grateful acknowledgment is made of this assistance and that obtained from numerous publications on occupations prepared in Canada and in other countries.

DIRECTOR,
Economics and Research Branch,
Department of Labour.

March, 1950.

MACHINIST AND MACHINE OPERATORS (Metal)

HISTORY AND IMPORTANCE

As man began to use metals, the problem of shaping them for use in agriculture, hunting, and war became a vital one. From the hammering of soft copper into useful forms to the alloying of copper to make harder bronze was a step involving the use of heat, and the forge developed as a result. The more refractory metal, iron, was next conquered, and accident probably produced steel. Harder pieces of steel were made into files to sharpen and shape other steel objects; the grindstone still did the rough work of sharpening.

Two very important inventions made possible the production of machines by machines. The first was James Watt's single-acting steam engine (and later his double-acting engine), prime movers capable of exerting any amount of force and yet under perfect control. The second was the invention of the slide-rest by Henry Maudsley and its introduction to other machines besides the lathe. This solved the problem of producing geometrically straight lines, planes, circles, cylinders, cones and spheres, required in the detail parts of the machines. Thus it became possible to produce the forms of the individual parts of machinery with a degree of ease, accuracy and speed that no accumulated experience of the hand of the most skilled workman could give.

The introduction of steam power made possible the rapid rotation or back-and-forth motion of a hard steel tool or of a piece of material, and the machine lathe came into being as an adaptation of the foot-power wood lathe. These machines made practicable the manufacture of better power units, and the late eighteenth century saw "machines for making more machines" coming into increasing use.

The work was still in individual jobs, and the need for skilled craftsmen who could undertake these jobs from beginning to end created the occupation known now as "Machinist".

One class of article was always needed in quantity, and standardized. This was weapons of war. It is not surprising that the first quantity-production recorded is that of muskets, with interchangeable parts, in the last decade of the 18th century. As one man could hardly do all operations on all parts, the work became subdivided, and the maker of a single part did not need the full skill of a machinist. Thus began the assembly-line, now a feature of industry. For much factory work, the machinist now sets up the tools and material to be used by the less skilled worker. Still, however, the original of all jobs must be made and fitted individually, and much heavy machinery is still an isolated job to specifications, requiring skilled work on every part. This monograph will therefore deal separately with the two categories "Machinist" and "Machine Operator".

MACHINIST (Metal)

DUTIES

The general machinist is a highly skilled mechanic who can make or repair metal machinery and equipment parts from metal stock, using various machine tools, and can fit and assemble machine parts with machinist's hand tools. He studies blue-prints and specifications, decides which machines and tools are needed and the order of their use. He lays out, measures and marks the work on the correct type of metal, using micrometers and other precision instruments. He sets up the metal in the various machines, such as the engine lathe, boring-mill, milling machine, grinder, planer, shaper and power hacksaw, and controls cutting and feeding speeds by changing gear and pulley combinations. He hand-finishes the job, and assembles the parts with bolts, screws or welding. He may set up a job on a machine to be operated by a less skilled man.

Machinists must be able to use shop mathematics, including fractions, decimals and simple algebra. They must know the working characteristics of various steels, iron, brass and other metals.

The United States Dictionary of Occupational Titles has some twenty-eight sub-classes under this heading, and specialized or limited duties of each may be found in that publication. They include automobile, camera, linotype, marine, maintenance, marine gas engine, pipe, brake, lock and repair machinists.

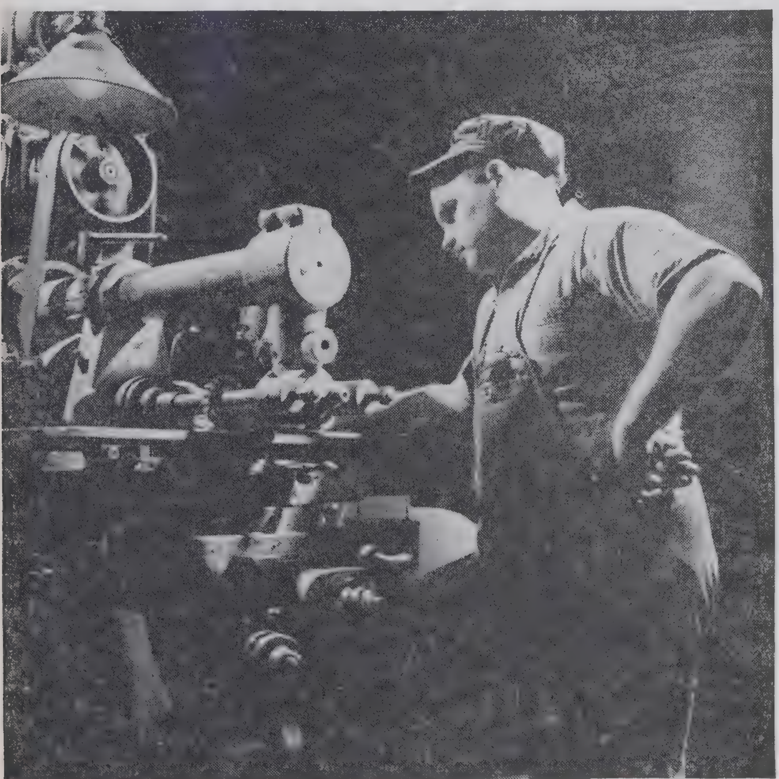

Photo N.F.B.

"Studying the job"

In modern machine industry the tendency is for machinists to be employed largely in the more intricate jobs requiring the highest degree of accuracy, and to employ machine operators (lathe hands, etc.) to turn out production work on machines "set up" by a general machinist.

QUALIFICATIONS

A young man interested in machinery, fond of working with tools, with good eyesight, mental alertness and ability to co-operate in teamwork is an excellent candidate for machinist training. He should have at least complete public school education, should be able to understand and apply elementary mathematics, and be prepared to learn under direction over a period of years.

It has been found that men with better than average education more readily adapt themselves to the changing requirements of technology and industrial progress.

TRAINING

Preliminary training, which is very desirable, may be obtained as follows:

(a) At technical schools in larger centres across Canada, and at smaller centres (Centres d'Initiation Artisanales, etc.) in the case of the Province of Quebec. The typical Quebec course lasts 52 weeks. There is also in that province a complete 3-year course, leading to a certificate (E.A.M.).

(b) Trade schools provide, in some cases, reasonably good preparation for machine operation.

(c) Dominion - Provincial Vocational Training 6 months' courses cover approximately the first two years of apprenticeship.

Apprenticeship is legally compulsory and formal in British Columbia only. Industry usually accepts apprentices on a four-year basis. The practical work is supplemented by class instruction, correspondence courses or night school. Pay starts at 35¢ to 45¢ per hour, with increases every six months, as a rule. Individual firms set their own standards.

One of the largest engineering firms has a five-year machinist's apprenticeship plan, including the principles of patternmaking and foundry work. It is intended for youths between the ages of 16 to 18, who have completed grade X, can pass a medical examination, and give evidence of good character.

ENTERING

An improver or a journeyman may obtain employment through the National Employment Service, or through direct application. In many cases he will be employed by the firm with which he trained. A tool kit, costing up to $250.00, is a personal requirement, but this is usually acquired during training.

After completion of apprenticeship, the machinist will continue to add to his knowledge and skill for many years, particularly in a job shop. In production work, he must keep abreast of the development of new methods and new machines.

EARNINGS

Wage rates averaged 94¢ per hour for Canada in 1943. This represented a low of 90¢ and a high of $1.01. The 1941 rates were about 30 per cent above those of 1939. A 48-hour week was general in war time, but post-war conditions have modified this, and wage rates are still undergoing adjustment. In June 1948 a fairly average figure for most of Canada was $1.08, rising to $1.27 in British Columbia.

The following sample hourly rates are taken from October 1948 records. They cover firms manufacturing machinery for industrial, office or domestic use, as well as foundries. They apply to machinists.

Charlottetown	**$0.93**	**Winnipeg**	**$0.96 to 1.13**
Amherst, N.S.	**1.00**	**Regina**	**0.80 to 1.00**
Saint John, N.B.	**0.90 to 1.13**	**Calgary**	**1.00 to 1.10**
Montreal	**0.96 to 1.35**	**Edmonton**	**0.90 to 1.25**
Toronto	**0.95 to 1.32**	**Vancouver**	**1.05 to 1.45**
Hamilton	**1.00 to 1.30**		
London	**1.01 to 1.10**		

In the automobile industry some typical rates are:

$1.08 to 1.20
1.22 to 1.32
1.24 to 1.43
0.90 to 1.15
0.85 to 1.05

A 44-hour week, time and a half for overtime, and vacations with pay, are becoming general with most large firms employing machinists.

The wage trend from 1920 to 1941 can be followed in "Wages and Hours of Labour in Canada, 1929, 1940 and 1941, Report No. 25", supplement to the Labour Gazette, October 1942. Cyclical effects can be clearly seen. The greater strength of labour unions at present may modify such effects in future.

This trade is especially affected by the varying demand for durable consumer goods, and for production machinery. When the demand contracts, the special skills the machinist has may enable him to compete successfully with less qualified men for such jobs as operating a machine.

ADVANCEMENT

A machinist may advance to foreman or to tool-maker or die-maker. Higher educational qualifications are a distinct advantage to those intending to take a university course in mechanical engineering or industrial engineering. Many executive and administrative officials in industry have been trained machinists.

RELATED OCCUPATIONS

(a) With university training: mechanical or industrial engineer.
(b) With further experience: tool-maker or die-maker, instrument maker, tool designer, shop foreman, superintendent or manager of works.
(c) Leading to machinist, with training: machine operator, repair mechanic, automobile mechanic, welder, steam-fitter, patternmaker (metal).

(d) Service trades: "Machinist B. and C.", "Machinist" and "Machinist Coxswain (A)", "Artificer (A. and B.)" — (Army). "Ordnance Artificers", "Engine-room Artificers" and "Dockyard Artificers" — (Navy). "Machinist" and "Armourer" — (R.C.A.F.).

ADVANTAGES AND DISADVANTAGES

The trade of a machinist is a constructive one, with much individual responsibility. Many jobs will provide satisfaction in the achievement of a difficult task. Pay is good, and union organization and security are well established. The craftsman is not tied to a single industry, and may find variety of work by moving.

Holidays with pay, workmen's compensation, the benefit of Unemployment Insurance, and in many plants health services, recreational facilities or organizations, and sanitary working conditions, are advantages in this occupation.

Cyclical influences are the principal drawback to this trade; training for full skill takes a long time. There are some hazards, including metallic dust, mostly avoidable, in the work, but standing for long hours, and eyestrain on precision jobs, as well as the noise of machines, may affect health.

PLACES OF EMPLOYMENT

Machinists are employed in factories making machinery or machine tools, metal articles, electrical apparatus, automobiles and aircraft, generally anything of metal requiring precision work. Railroads, mines and shipyards also use many machinists. The work may be new manufacture or maintenance repair. All large factories need one or more machinists for maintenance work. Custom machine shops, usually with a small staff, are another field of work for this trade.

ORGANIZATIONS

Machinists are usually members of a craft union.

MACHINE OPERATORS (Metal)

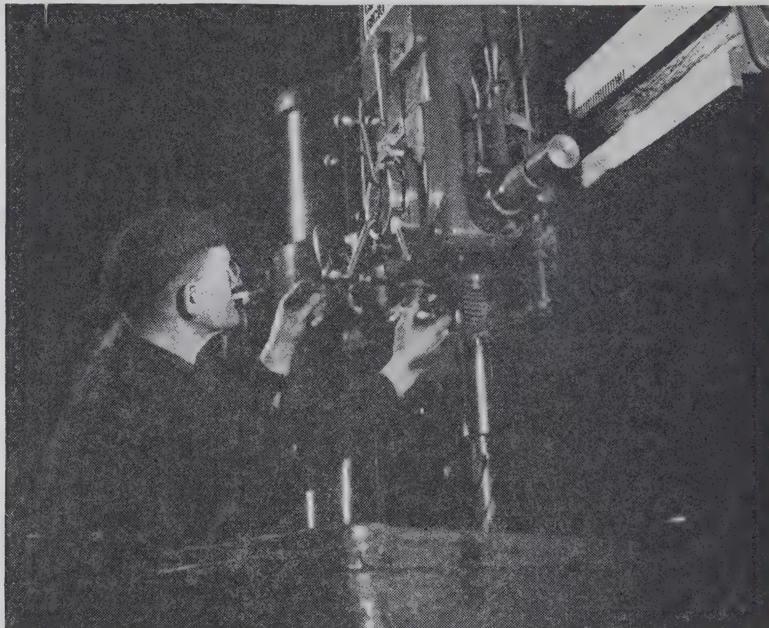

Photo N.F.B.

"Adjustment must be perfect"

DUTIES

A machine operator (metal) operates one of the following types of machine:

Engine and turret lathes
Vertical and horizontal boring-mills
Milling machines
Planers
Shapers
Drill presses
Precision grinders

This work is usually done under direction, with the job "set-up" by a machinist, and much of it is repetitive.

QUALIFICATIONS

An interest in and liking for machinery, a reasonably good physique, nervous stability, ability to follow and obey instructions, and to work standing, good eyesight and muscular co-ordination, are necessary in this work. It is possible for physically handicapped persons using prosthetic devices to operate some of the machines. Women have been employed in this work, mostly under war conditions.

TRAINING

Dominion-Provincial Vocational Training, many technical schools and a number of trade schools, have courses which prepare for this type of work, especially useful for one who aims at ultimate qualification as a skilled machinist. In some cases credit is given on machinist's apprenticeship for such training.

ENTERING

The National Employment Service is the principal channel of entry. Application to individual firms "at the gate" was formerly the general practice, and is still adopted to some extent.

ADVANCEMENT

Working on various machines may be of value if apprenticeship as a machinist is later taken. Machine operators can advance to leading hands in charge of small groups of men operating similar types of machine and to sub-foreman and foreman in charge of all the machines in the department.

EARNINGS

The variety of jobs and of industries employing machine operators is such that no average wage can be estimated. In the metal industries generally hourly rates compare favourably with those for jobs involving similar degrees of skill in other manufacturing groups.

Some sample recent rates for operators of metal-shaping machines outside of the automobile industry are as follows:

GENERAL MACHINE OPERATORS

Amherst, N.S.	$0.80 to 0.90
Montreal	0.90 to 1.20
Toronto	0.90 to 1.32
Hamilton	0.87 to 1.23
London	0.85 to 0.95
Winnipeg	0.80 to 1.13
Regina	1.05
Calgary	1.01
Vancouver	0.92 to 1.23

In the automobile industry some rates are:

Punch press operators	$0.94
Hydro press operators	1.07
Milling machine operators	1.11 to 1.35
Shear operators	0.98 to 1.12
Drill press operators	1.15 to 1.35
Lathe operators	1.14 to 1.35
General operators	1.12 to 1.52

(It is probable that the higher rates include those for men in a supervisory capacity).

ORGANIZATIONS

Machine operators are to a great extent members of industrial unions appropriate to the branch of industry in which they are employed.

ADVANTAGES AND DISADVANTAGES

The chief advantages in this occupation are the relatively high rate of pay, and the opportunity for overtime which may be present when production must be rushed. The social and economic advantages of employment in large establishments, which form a considerable proportion of all employers of this group, are not negligible. The benefits of workmen's compensation and unemployment insurance legislation, as well as the paid holidays granted by some large firms, are also worth consideration.

The major disadvantage of this type of work is the fluctuation in labour demand, which depends largely on the activities of heavy metal products manufacture.

TRENDS (Both Machinist and Machine Operator)

Number in Occupation

Roughly speaking, there have in recent years been approximately two machine operators to one machinist in custom machine shops. However, the following industries employ mainly skilled machinists: Railways, paper mills, mines, airlines.

The proportion of operators to machinists is at least 10 to 1 in the following plants:

Aircraft
Automotive (sometimes 20 to 1)
Agricultural implement

In most other branches of the metal-working industry the proportion of two operators to one machinist may be regarded as an average one.

The totals for Canada were estimated, as a result of a survey conducted by the Department of Veterans Affairs, as being at the end of 1946:

34,240 machine operators
18,170 machinists

Fluctuations in these figures will necessarily occur as industry expands or curtails its activities.

The trend at present is towards an increase in the proportion of semi-skilled and unskilled workers to skilled.

The number of "machinists" in Canada as listed in the census figures rose from about 32,500 in 1931 to nearly 46,000 in 1941; the latter figure reflects, of course, the early phases of war industry (Dominion Bureau of Statistics No. 06, Table 7). It is probable that not more than 40 per cent of these can be considered as skilled machinists in the proper sense of the term.

In view of the marked changes in the metal industries since 1941, census figures on distribution of these occupations by industry are not given here.

The needs of war industry, and the assembly-line methods necessary for production, undoubtedly caused many hastily-trained persons to perform duties calling for a limited degree of the skill and knowledge of a machinist. With the cessation of war contracts, and the absence, in certain sections of Canada, of any peace-time industry to replace "mushroom" war plants, a very large number of persons calling themselves "machinists" were without employment. Where reconversion was a practical matter, in the normally industrial areas, the partly-skilled sometimes found themselves out of a job, or reverted to machine operation only.

PRESENT DEMAND AND SUPPLY

The following data are taken from the records of the National Employment Service. It must be remembered that not all vacancies are registered with the National Employment Service, and that engagements are frequently made direct by the employer.

MACHINISTS, TOOL-MAKERS AND DIE-MAKERS

	Unfilled Vacancies	Applicants
August 1948	266	748
December 1948	133	1,340
March 1949	128	1,677

OTHER MACHINE SHOP WORKERS

	Unfilled Vacancies	Applicants
August 1948	337	457
December 1948	109	968
March 1949	101	1,294

In considering these figures the possibility of workers whose skills might properly place them within the latter group describing themselves as "machinists" should be taken into account. Separate data for the three trades shown in the former group are not available.

The ability of industry to plan production in relation to anticipated consumer needs and effective purchasing power will be a most powerful factor in the stability of a machinist's employment.

Training of machinists is almost certainly reverting to the pre-war apprenticeship system, and standards of performance will become high, eliminating from the labour force left by the war the insufficiently trained and those lacking necessary skill and judgment. The new materials, such as aluminium and magnesium alloys, developed during and since the war, will call for new techniques.

A machine tool industry is in process of development in Canada, and this may have a favourable effect on this occupational group.

Generally speaking, the prospects for machine operators will vary from those for machinists in one important respect. They will be influenced considerably more by the activity of the automotive industry.

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AUDIO-VISUAL MATERIAL

Readers desiring information on film sources, other available material, and the organization of local film services may obtain it from National Film Board offices as listed in Monograph 1, "Carpenter".

LOCAL INFORMATION

"CANADIAN OCCUPATIONS" SERIES

The monographs listed below, accompanied by pamphlets in the case of numbers 1 to 8, have been published to date. Those from 20-35 have been published collectively.

(1) *Carpenter*

(2) *Bricklayers and Stone Masons*

(3) *Plasterer*

(4) *Painter*

(5) *Plumber, Pipe Fitter and Steam Fitter*

(6) *Sheet-Metal Worker*

(7) *Electrician*

(8) *Machinist and Machine Operators (Metal)*

Careers in Natural Science and Engineering: (20-35)

(20) "Agricultural Scientist"

(21) "Architect"

(22) "Biologist"

(23) "Chemist"

(24) "Geologist"

(25) "Physicist"

(26) "Aeronautical Engineer"

(27) "Ceramic Engineer"

(28) "Chemical Engineer"

(29) "Civil Engineer"

(30) "Electrical Engineer"

(31) "Forest Engineer and Forest Scientists"

(32) "Mechanical Engineer"

(33) "Metallurgical Engineer"

(34) "Mining Engineer"

(35) "Petroleum Engineer"

DEPARTMENT OF LABOUR

Economics and Research Branch

OTTAWA, 1950

OTTAWA
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MONOGRAPH 8

REVISED 1958

DEPARTMENT OF LABOUR, CANADA

All monographs in the "Canadian Occupations" series are priced at 10 cents per copy, with the exception of *Careers in Natural Science and Engineering*, which is 25 cents. A discount of 25 per cent is allowed on quantities of 100 or more of the same title.

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CANADIAN OCCUPATIONS

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MACHINIST and MACHINE OPERATORS (Metal)

MONOGRAPH 8

REVISED 1958

HON. MICHAEL STARR, MINISTER

A. H. BROWN, DEPUTY MINISTER

DEPARTMENT OF LABOUR, CANADA

PRINTED IN CANADA

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Price: 10 cents

FOREWORD

During recent years there has been a steadily increasing demand for Canadian occupational information. This demand comes from youth faced with the need of choosing an occupation and preparing for it; from parents, teachers and vocational guidance counsellors; from workers wishing to change their occupations; from employment service officers; from personnel directors and union officials, and from other quarters.

The "Canadian Occupations" series of monographs is designed to help meet this demand. Each booklet describes, among other things, the nature of the occupation or group of occupations, entrance and training requirements, working conditions and employment outlook.

Occupational information tends to become dated as a result of changes in economic conditions, industrial technology, wage and salary structure, etc. Revision of outdated publications is a regular feature of this series, and space is left in the last few pages of each monograph for recent changes and other local information concerning the occupation.

This series has been prepared with the generous assistance of representatives of management, trade unions and professional associations. The co-operation of the Unemployment Insurance Commission, the Vocational Training Branch of the Department of Labour, and the Dominion Bureau of Statistics is gratefully acknowledged.

The present monograph was revised and written by William Allison, Chief of the Occupational Analysis Section. Acknowledgment is extended to Canadair Limited for illustrations, and to the International Association of Machinists for assistance in checking the textual material.

DIRECTOR,
Economics and Research Branch,
Department of Labour.

January 1958.

MACHINIST AND MACHINE OPERATORS (Metal)

Photo: N.F.B.

Machine shops are basic to modern industry.

HISTORY AND IMPORTANCE

We need only to look around us to appreciate the importance of metal products in our daily lives. Automobiles, locomotives, household appliances and utensils, engines, machines and tools of all kinds are composed mainly of shaped metal parts. Furthermore, practically all non-metal goods are manufactured by machines that are made of metal. Metal-working is thus an essential

part of modern industry, and calls for the skills of a variety of metal-working craftsmen, including machinists and machine operators.

The shaping of metals for his own use was one of man's early problems. The hammering of soft copper into useful articles marked the beginning of his metal-working activity. The alloying of copper with tin to make bronze involved the use of heat and led to the development of the forge, in which heated metal is pounded into shape. Another early method of shaping metal consisted of pouring the molten metal into moulds to make castings. This led to the foundry processes. When man learned how to grind and cut metals to desired shapes, the trade of the metal machinist was born.

Early methods of grinding and filing metals were laborious and crude, but several important inventions were to change metal shaping and assembly methods. These ushered in the Industrial Revolution of the 18th century and the remarkable developments in manufacturing that were to follow.

The harnessing of steam power by James Watt provided the continuous force needed to rotate a piece of metal stock against a hard cutting tool. The invention of the slide rest by Henry Maudsley, and its application to other machines besides the lathe, solved the problem of cutting metal into straight line, flat-surface, circular, cylindrical, conical and spherical shapes. This made it possible to produce the shapes for individual parts of machinery with a degree of ease, accuracy and speed not matched by the hand of the most skilled craftsman.

The third great stride toward modern production methods was contributed by Eli Whitney, an American better known, perhaps, for his invention of the cotton gin. Up until the turn of the 19th century, manufacturing was largely on a "job" basis, in which a skilled craftsman made and fitted individual parts, and assembled them to make the finished product. From his experience in making the cotton gin, Whitney conceived the idea of making interchangeable parts for muskets, which were needed in large numbers. This process made it possible to subdivide the work, a number of craftsmen turning out large numbers of individual parts, each identical to its mates. Muskets of standardized pattern, with interchangeable parts, could thus be made up in quantity. This marked the beginning of mass production, a process later to be refined by Henry Ford in the manufacture of low-priced automobiles.

Technological developments such as these had an important effect on the metal-working crafts. Before the subdivision of labour, a skilled craftsman was required to undertake, from start to finish, the manufacture of a product. The introduction of specialized machines to carry out individual steps of production permitted the employment of machine operators skilled only in one operation.

Skilled metal-working craftsmen are concentrated in highly industrialized countries, and Canada is relatively young as an industrial power. Entering the 20th century as a predominantly agricultural country, Canada emerged from World War II with the emphasis changing to industry, particularly manufacturing. This shift has resulted in an increased demand for craftsmen skilled in industrial processes, especially machinists and metal-working machine operators.

FIELD OF WORK

Machinists and machine operators work in machine shops, situated wherever mechanized industry has become established. Machine shops may be classified roughly into three different types, according to function—*job* or *custom machine shops*, *production machine shops* and *machine repair shops*—although the demarcation is not always clear, and there is often some overlap in function.

Job Machine Shops are most versatile, since they are capable of doing practically any type of metal machining within the limits of their equipment, including repair work. Their main function is to produce limited quantities (one to a few thousand) of a wide variety of metal parts made to the specific requirements of customers. They are located wherever a sufficient concentration of industry warrants their existence.

Owing to the wide variety of work in job or custom machine shops, it is to be expected that a considerable proportion of the staff would be skilled all-round machinists, capable of carrying out any type of machining likely to be required. Since production does not ordinarily run to large numbers, there is less need for the machine operator.

Production Machine Shops are usually the main departments of companies manufacturing large quantities of hard consumer goods, such as automobiles, aircraft, household appliances, typewriters,

military weapons and the like. Production shops are situated mainly in large industrial centres, such as Toronto, Hamilton, and Montreal, or in towns where a large manufacturing plant provides the main source of employment.

The large proportion of workers in these shops are machine operators, although highly skilled all-round and specialist machinists and other technical workers are required to plan, organize and set up the production processes.

Machine Repair Shops are usually attached to any factory or establishment where the need for maintenance and repair to machinery warrants the employment of one or more machinists to carry out such work. These shops are usually located within a factory or power plant, and may vary in size from a corner in the engine room to separate, well equipped departments. The nature of the work requires versatile, all-round machinists and mechanics.

Photo: N.F.B.

The machinist is a skilled craftsman.

MACHINIST

NATURE OF THE WORK

The *all-round machinist* is a highly skilled craftsman who makes or repairs parts for metal machinery and equipment, using a variety of hand and machine tools. Two outstanding characteristics of the machinist's work are the wide variety of operations that he is required to carry out, and the high degree of accuracy (tolerance) to which he must work.

He operates all the standard metal-working machine tools, such as the drill press, engine lathe, boring machine, milling machine, grinder, planer and shaper, and power hack-saw, in addition to any machines designed for special operations. He also uses a number of hand tools, including scrapers, files, scribers, micrometers and calipers. He finishes machine parts, and fits and assembles them.

The machinist's work requires a thorough knowledge of blueprint reading and job specifications, shop mathematics, machine shop practice, working properties of commonly used metals, heat treatment methods, and the use of standard bolts, threads and screws.

Specialist Machinists

Although the well qualified machinist is capable of carrying out all the operations in planning, marking out, setting up and fitting any project, many machinists—particularly those in production shops—specialize in one phase of the work. The *set-up man*, for example, may be assigned to a number of machines on which he sets up the cutting tools and adjusts the controls. After making a test run and checking the results, he turns the machine over to an operator to make the production run. The *lay-out man*, using templates, or measuring from base lines, makes marks on the metal stock before it is machined to guide the machine operator.

It is not uncommon for fully qualified machinists to specialize in the operation of a particular type of complex machine in order to earn higher wages, although in doing so, they run the risk of losing their all-round skill.

QUALIFICATIONS

Mechanical interest and aptitude are the main personal qualifications required, together with good eyesight and mental alertness. Since formal training may extend over a number of years, including evening classes or home study, the prospective machinist should be prepared to forego attractive wages in less skilled occupations in return for the long range goal of qualified craftsmanship.

PREPARATION AND TRAINING

The minimum education for young men proposing to become qualified machinists is considered to be complete public school. Many firms having formal plant training and apprenticeship programs demand at least two years of secondary school, preferably in shop subjects. It has been found that men with better than average education more readily adapt themselves to the changing requirements of technological progress.

Prospective machinists now have the opportunity for considerable preparation in the trade at the secondary school level. Many technical and vocational schools have machine shop equipment and offer practical and theoretical shop courses, including shop mathematics, physics, metallurgy, mechanical drawing, blueprint reading and machine shop practice.

Apprenticeship

The usual way to become a qualified machinist is through formal in-plant training or by serving an apprenticeship, lasting about four years. In British Columbia, Alberta and Newfoundland the machinist's trade is regulated by a provincial apprenticeship program. In Nova Scotia and New Brunswick the trade is designated for apprenticeship in certain companies. Many large plants in Canada have made their own provision for a continuing supply of qualified craftsmen by setting up well developed in-plant training programs.

The training that apprentice machinists receive varies from plant to plant, although efforts are being made to standardize it so that qualifications will be more uniform throughout the trade. In some cases beginners may be expected to "pick up" the trade skills as they work around the shop. In other plants with organized

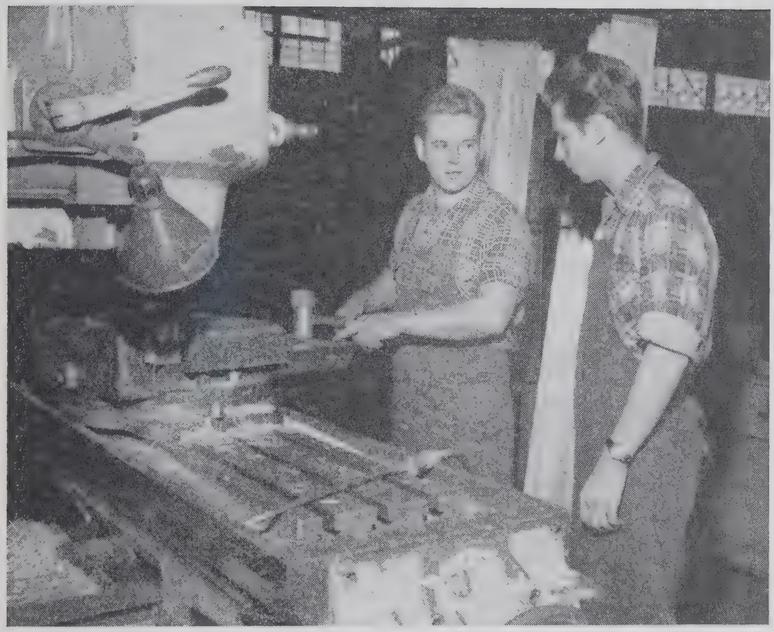

Photo: N.F.B.

The apprentice learns from the journeyman.

training plans, training will consist of practical instruction in each department of the shop under the guidance of qualified machinists and instructors.

Apprentices usually start out by working in the tool and steel crib, learning the proper names of tools and supplies, how to operate power hack-saws and other equipment, and how to keep tool and stock records. They will be concerned with learning to read the blueprints and specifications used in the shop and they may even spend some time in the drafting office. They learn how to use precision measuring instruments such as micrometers and gauges, and to develop skill with hand tools for finishing and fitting. They become proficient with practice on the lathe and other machine tools, and learn the variety of uses to which they may be put, as well as their limitations. In time, apprentices learn how to plan individual jobs and to carry them through to completion in an efficient manner.

Those who train by apprenticeship may be required to increase their practical and theoretical knowledge by attending night classes at local technical schools. A number of useful home study courses are available to trainee machinists. Appendix A lists a few Canadian Vocational Correspondence Courses offered by provincial Departments of Education to all residents of Canada.

During training, apprentices must gradually acquire a collection of hand tools and instruments. These amount to about $250.00 in value, more or less, and the firm may assist in their purchase.

ENTRY

Students leaving school to find their first job may apply to local offices of the National Employment Service, where they will be given every assistance in locating a suitable training situation. Students graduating from secondary schools where they have received shop training may obtain assistance from the school placement officer. In provinces where the trade is designated for apprenticeship, local apprenticeship authorities should be in a position to advise prospective machinists regarding training opportunities.

Many employers use the employment columns of daily newspapers to advertise their requirements for qualified machinists and apprentices. Job-seekers may also apply directly to employing firms, and employment leads can be located in the Yellow Pages of the telephone directory under "Machine Shops", "Machinery", "Steel", etc.

Those intent on becoming well qualified machinists should select firms known to have good training programs. Application should be made as early as possible, since such firms generally have a waiting list. These firms are selective about taking on apprentices, preferring those with good educational background and vocational or technical school training. Some firms make it a practice to give preference to applicants who are recommended by their own employees, and it may be valuable, therefore, to have friends already in the trade.

WORKING CONDITIONS

Earnings

Remuneration for qualified machinists and apprentices varies widely, depending on locality, type of industry and degree of proficiency and experience.

Table 1 — HOURLY WAGE RATES FOR MACHINISTS IN SELECTED INDUSTRIES, OCTOBER 1956

	Average $	Predominant Range $
Mining		
Gold	1.47	1.25 — 1.55
Iron	1.98	1.75 — 2.15
Metal Mining (Except Gold & Iron)	2.05	1.59 — 2.33
Coal	1.49	1.40 — 1.66
Manufacturing		
Food & Beverages		
Slaughtering & Meat Packing	1.92	1.59 — 2.21
Tobacco, Cigars & Cigarettes	2.02	1.88 — 2.15
Paper Products		
Paper Boxes & Containers	1.74	1.54 — 2.02
Maintenance (Pulp & Paper)	2.16	1.33 — 2.32
Iron & Steel Products		
Agricultural Implements	1.66	1.25 — 1.94
Heating & Cooking Apparatus	1.70	1.16 — 2.02
Household, Office & Store Machinery	1.53	1.28 — 1.81
Iron Castings	1.88	1.30 — 2.41
Machine Shop Products	1.76	1.40 — 2.15
Machine Tools	1.87	1.53 — 2.22
Special Industrial Machinery	1.75	1.28 — 2.10
Primary Iron & Steel	2.31	1.94 — 2.46
Sheet Metal Products	1.86	1.56 — 2.02
Transportation Equipment		
Aircraft & Parts	1.91	1.60 — 2.27
*Motor Vehicles	2.07	2.04 — 2.18
*Motor Vehicle Parts & Accessories	2.04	1.81 — 2.19
Railroad & Rolling Stock Equipment	1.77	1.74 — 1.79
Shipbuilding & Repairing	1.71	1.20 — 2.05
Electrical Apparatus & Supplies		
Heavy Electrical Machinery & Equipment	1.89	1.47 — 2.04
Radio, Television & Other Electronic Equipment	1.74	1.45 — 2.03
Refrigerators, etc.	1.67	1.25 — 2.09
Miscellaneous		
Brass & Copper Products	1.73	1.47 — 2.13
Clay Products	1.64	1.41 — 1.90
Petroleum Refining & Products	2.24	1.80 — 2.32
Acids, Alkalis & Salts	2.02	1.87 — 2.21
Electric Light & Power	2.00	1.52 — 2.25

SOURCE: Department of Labour, Ottawa. *Wage Rates and Hours of Labour in Canada*, October 1956.

*Ontario only.

Generally speaking, apprentices in their first year receive 35 to 40 per cent of the journeyman rate. This percentage is increased at regular intervals, subject to satisfactory progress, until by the final year they receive 80 to 90 per cent of the journeyman rate. The quality of training received should be regarded as more important than the initial earnings.

The hourly wages quoted in Table 1 indicate what machinists earned in selected industries in Canada in 1956. Wage rates change rapidly. For current and local information readers are directed to inquire from local employers, union officials, or the National Employment Service.

ADVANCEMENT

After the apprentice has become a qualified machinist, advancement will depend largely on the direction of his skill, his preference

Photo: N.F.B.

Some machinists become inspectors.

to specialize, and his ability to assume added responsibility and leadership.

If he continues to develop his skill and craftsmanship, he may, with added training, become a *tool maker* or *die maker* and specialize in making the cutting tools, jigs, fixtures, stamps and dies used in the various machining operations. Eventually he may assist engineers in tool design work.

The machinist may also specialize in the operation of a single machine tool or in a special phase of machine shop work, such as set-up, lay-out or fitting.

Those with leadership qualities and the ability to organize and direct the work of others may advance to leading hand, shop foreman, master mechanic and, for the able few, to plant superintendent. Others may become inspectors and eventually chief of the inspection department. In the planning department there are opportunities to become methods analyst, time-study man or process analyst.

RELATED OCCUPATIONS

Training as a machinist opens up opportunities in many other fields, a few of which have been mentioned above. Other related trades are instrument maker, patternmaker or marine engineer.

Those with the ability to impart knowledge to others may find satisfaction as instructors of the trade in technical or trade schools. Machinists with a flair for salesmanship may become representatives for firms supplying the machine trade.

ADVANTAGES AND DISADVANTAGES

By far the largest number of machinists is employed in the manufacturing industry, and they share in the benefits and disadvantages associated with this sector of the economy. General working conditions, hours of work and wage rates have steadily improved. Health insurance schemes, holidays with pay and, in a few large plants, some form of guaranteed annual income, are some of the benefits that have resulted from union activity in manufacturing plants. Most employees are covered by Workmen's Compensation and Unemployment Insurance schemes.

The manufacturing industry is very sensitive to general economic conditions, however, and the combination of reduced consumer demand and large inventories results in cut-backs in production, with consequent lay-off of workers.

Machine shop work is not particularly strenuous, although workers are required to be on their feet much of the working day. Most modern machine shops are equipped with cranes and hoists for lifting heavy metal parts, and power equipment is used for heavy assembly jobs.

There are hazards involved in working with moving machinery, sharp cutting tools and heavy objects. Many plants employ a safety engineer whose job is to reduce to a minimum whatever hazards may develop. Protective clothing and equipment, such as goggles and steel-toed boots, and the use of rails, guards and other safety devices around machines, eliminate much of the danger of accident.

Health may be affected by metallic or grinder dust, and by the noise of machinery. Working to fine tolerances on precision jobs may result in eyestrain. Employers, however, are taking more and more precautions to protect workers from the ill effects or injury resulting from dust, eyestrain, fatigue and accidents.

Machinists are craftsmen whose skills are fundamental in an age of machinery, and they are thus one of a group of metal-workers without whom modern technology would be impossible. They may derive great satisfaction in carrying out precision work with machine and hand tools required to shape and fit the parts that keep the wheels of industry turning.

ORGANIZATIONS

Machinists may be members of their craft union, the International Association of Machinists, or of industrial unions covering all the workers in a single plant or industry, such as the United Automobile Workers.

* * *

After discussing the work of Machine Operators, the monograph covers the trends and outlook for both groups.

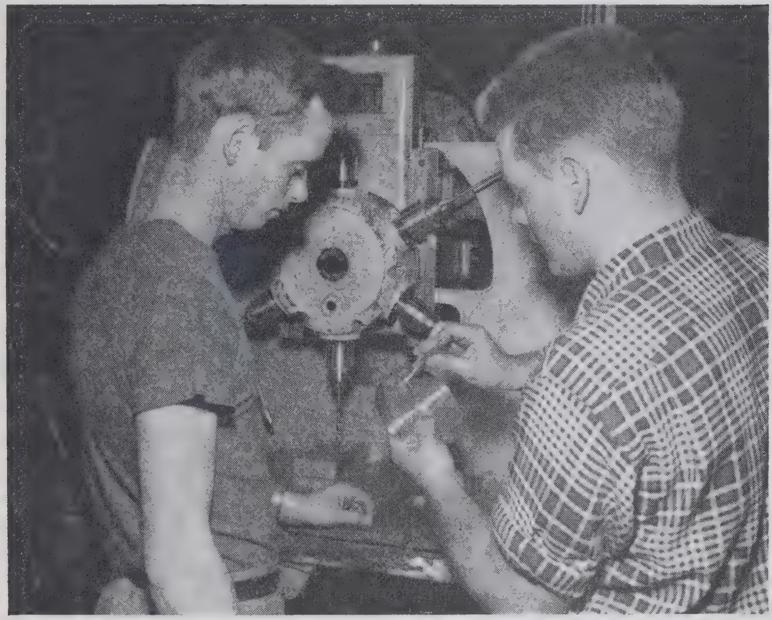

Photo: N.F.B.

The machine operator has his work set up by a machinist.

MACHINE OPERATORS
(Metal)

NATURE OF THE WORK

The *machine operator* is distinguished from the all-round machinist in the degree of skill and training required to do his job. The machine operator usually works under the direction of a machinist. He may work from blueprints or lay-outs, set up his machine for the required machining operations, adjust the feed and speed controls, and measure the work to make certain it meets specifications. He may know how to sharpen his cutting tools, and understand the machining qualities of various metals.

Indeed, the work of some machine operators may appear to be very much like that of the all-round machinist, except that it is limited to one type of machine.

The work of the majority of machine operators consists of tending or feeding a single type of machine tool that has been set up by a more skilled worker. They may make simple adjustments and check for irregularities. A feature of machine operation is the repetitive nature of the work.

Machine operators work with one of the many machines used in shops, such as engine and turret lathes, vertical and horizontal boring mills, milling machines, planers, shapers, drill presses, and precision grinders. They are often designated by the machine with which they work (e.g., milling-machine operator).

QUALIFICATIONS

An interest in and liking for machinery, a reasonably good physique, good eyesight and muscular co-ordination, and the ability to follow instructions, are necessary in this work. The noise and repetitive nature of much of the work may not be suitable for those of nervous or erratic temperament. The work usually requires the operator to stand and to have the use of both hands, although many physically handicapped persons have adapted themselves with prosthetic devices, often with dramatic results. Wartime experience demonstrated the suitability of women for many machine operation jobs.

TRAINING

Training is usually given on the job and varies with the type of machine and the degree of proficiency and responsibility expected of the worker. The skilled operator who is able to set up his machine and work independently may take one or two years to learn his job. Simple machine operation may only require a few days or weeks of training to reach efficiency.

The shop courses in many vocational or technical schools, or Arts and Crafts schools in Quebec, may assist young people in preparing for this type of work.

ENTRY

Obtaining employment as a machine operator is similar to the method outlined for machinists. First-job seekers are advised to enlist the help of the local office of the National Employment Service.

Employment as a machine operator is more casual than employment as a machinist because of the great difference in the skill and training involved. The career aspect of employment is greater for machinists than for machine operators.

ADVANCEMENT

Machine operators may advance by becoming more highly skilled and efficient in the operation of one machine, or by learning to operate another, more complex, machine. They may advance to leading hands in charge of a small group of workers operating similar types of machines and eventually become foreman in charge of all operators in a department.

Those who have taken employment as machine operator may eventually get the chance to train as apprentice machinist and the time spent as machine operator may be taken into consideration when the terms of apprenticeship are arranged.

EARNINGS

Generally, wages paid to machine operators are lower than those paid to qualified machinists in the same shop, although some operators working on a production basis may do better.

Wage rates vary across the country, as well as from industry to industry. Table 2 gives the Canadian averages for certain groups of machine operators in selected industries.

ADVANTAGES AND DISADVANTAGES

The chief advantages in machine operation are the relatively high rates of pay, including opportunity for overtime, and the relatively low training requirements. The social and economic advantages of employment in large establishments, which form a considerable proportion of all employers of this group, are worth consideration. Many of these firms have generous employee health and pension plans, paid vacations and recreational organizations. Workers are covered by Unemployment Insurance and Workmen's Compensation.

The major disadvantage of this type of work is the fluctuation in labour demand, which depends on the activity of heavy metal products manufacture. Machine operators are thus more likely to be laid off during retooling periods, or when production has temporarily exceeded demand.

Table 2 — HOURLY WAGE RATES FOR MACHINE OPERATORS IN SELECTED MANUFACTURING GROUPS, OCTOBER 1956[1]

	Drill-Press		Punch-Press		Lathe		Milling Machine		Grinder	
	Average	Predominant Range	Average	Predominant Range	Average	Predominant Range	Average	Predominant Range	Average	Predominant Range
	$	$	$	$	$	$	$	$	$	$
Agricultural Implements	1.31	.95-1.69	1.43	1.30-1.61	1.52	1.10-1.79	1.47	1.00-1.74	1.42	1.05-2.02
Heating and Cooking Apparatus	1.30	—	1.59	—	—	—	—	—	—	—
Household, Office and Store Machinery	1.72	—	—	—	1.66	—	—	—	1.67	—
Machine Shop Products	—	—	—	—	1.54	—	—	—	1.67	—
Machine Tools	—	—	—	—	1.82	1.60-2.02	1.76	1.57-2.02	1.81	1.50-2.08
Special Industrial Machinery	1.60	—	—	—	1.65	—	1.68	—	1.70	—
Sheet Metal Products	—	—	1.50	—	—	—	—	—	—	—
Aircraft and Parts	—	—	—	—	1.75	—	1.82	—	1.78	—
Motor Vehicle Parts And Accessories	1.79	1.50-1.89	1.61	1.20-1.84	1.83	1.53-1.95	1.86	1.52-2.23	1.86	1.69-2.00
Railroad and Rolling Stock Equipment	1.62	1.56-1.68	1.64	1.49-1.68	1.77	1.73-1.87	—	—	—	—

[1] In many cases not enough firms reported a particular group of machine operators to include in this table or to give an average or predominant range of wages.

SOURCE : Department of Labour, Ottawa, *Wage Rates and Hours of Labour in Canada*, October 1956.

TRENDS (Machinist and Machine Operators)

Number in Occupation

The number of machinists in Canada has shown a remarkable increase since 1931. It is estimated that in that year there were slightly more than 18,000. In 1941 there were approximately 25,000 and by 1951, the Census indicated that the number had grown to about 31,000. This represents an increase of about 72 per cent in the 20-year period, compared with an increase of about 23.8 per cent in the male labour force over the same period. The number of machinists in industry has therefore increased three times as fast as the male labour force.

Comparable figures are not available to show the growth of the number of machine operators during the period 1931-51. However, the Census of 1951 shows a total of 35,000.

Women in the Occupation

The number of female machinists is negligible. Wartime experience has shown that women are readily adaptable to the operation of light production machines, however, and there were nearly 4,000 female machine operators (metal) in Canada in 1951.

Age Groups

There is a significant difference between the ages of machinists and machine operators, according to the 1951 Census. At that time 21 out of every 100 machine operators were in the 14-24 age group. The comparable figure for machinists was 13 out of every 100. The greater number of young machine operators suggests that this type of work provides many entry jobs for younger workers, some of whom may later qualify as machinists.

Industrial Distribution

Although machinists and some machine operators are employed in practically every industry, they are concentrated in manufacturing. In 1951 manufacturing employed 82 out of every 100 machinists and 97 out of every 100 machine operators. The greatest concentrations were in the metal products industries, where machine operators outnumbered machinists nearly two to one. On the other hand, in non-metal manufacturing and all other industries machinists outnumbered the machine operators nearly five to one.

The Province of Ontario, being highly industrialized, accounts for 51.5 per cent of the machinists and 66.5 per cent of the machine operators in Canada; Quebec follows with 27.4 per cent and 23 per cent respectively.

Technological Change

The series of inventions and discoveries that introduced the Industrial Revolution and, incidentally, the trades of machinist and machine operators, has continued through the years. The development of new tools, processes and materials has tended to change the skill requirements for many of the metal-working trades. It is only in the last 50 years, for example, that lathe work could be carried out with any high degree of accuracy. Prior to that much of the work had to be finished by a process of precision grinding. Improved presses and dies that make possible the use of sheet-metal for the fabrication of some parts that are normally machined is another example of a change that might affect production processes.

Automation, which is a specialized aspect of technological change, may have a significant impact on the work of machinists and machine operators. The most important development in this regard is the application of automatic control devices for operating machine tools.

Automatic control involves the use of cards or tape on which are punched coded instructions governing the length, direction and depth of cuts, dimensions, tolerances, selection of cutting tools and sequence of operations. All that is required then is to feed the card or tape into the electronic control device and the machine produces the part automatically, without human intervention. This type of automation is particularly suited to short-run job shop requirements because the machine can be readily switched from job to job, and the tapes and cards can be stored for future use.

It is still too early to assess the ultimate effects of recent technological change, particularly in the metal-working industries. It is expected that the effects of automatic equipment and production processes, if widely adopted, will be toward a proportionate reduction in the need for semi-skilled machine operators and an increase in the proportion of skilled maintenance workers, including machinists.

Many machine operators will, of course, continue to be employed, but it will be increasingly important for them to have a

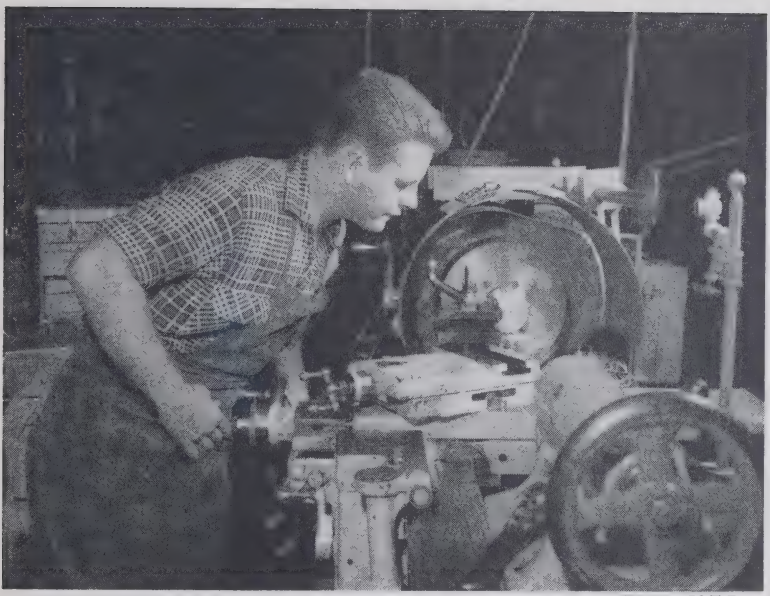

Photo: N.F.B.

The machinist may have to adapt to new production methods.

strong sense of responsibility since they will be working with very complex and expensive machines. It may also be necessary for them to have at least a rudimentary knowledge of electronics, hydraulics and pneumatics in order to understand the operation of automatic devices.

There are many factors that may limit the rapid or widespread adoption of automatic production, the main ones being the present high cost of automated equipment and the fact that automation can not be applied indiscriminately to any industry or industrial process.[1]

(1) The question of technological change and its effect on employment is far too complex to be dealt with in this monograph. For a thought-provoking treatment of the subject the reader is directed to a report entitled *Probable Effects of Increasing Mechanization In Industry,* presented by the Canadian Labour Congress to the Royal Commission on Canadian Economic Prospects. (Queen's Printer, Ottawa, Canada. $1.50)

The preliminary results of a research program being carried on by the Department of Labour, Canada, in co-operation with other agencies, is contained in Report No. 2, *Technological Changes and Skilled Manpower: Summary Report on the Electrical and Electronic Industry and the Heavy Machinery Industry,* 1957. This report is available on request from the Economics and Research Branch, Department of Labour, Ottawa, Canada.

Outlook

Machinists and machine operators are key workers in any economy based primarily on the use of metal products. The machinist's skill will never become obsolete, although it may change in character.

The number of establishments employing these workers has shown steady increase, and although employment has fluctuated sharply from time to time owing to business conditions, there is a substantial long-term growth. Because of the general economic expansion and increased industrialization expected in Canada for the next two decades, the demand for workers should remain high.

It should be readily apparent to those who are considering this work as a vocation that the qualified machinist with a good academic background will be better prepared to adapt to changes in the trade than the one whose training is narrow and specialized.

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FILMSTRIP

The Department of Labour has collaborated with the National Film Board in producing the filmstrip *Machine Shop Occupations*, based on this monograph. It describes, with authentic pictures, the nature of the work, training, working conditions, employment outlook, and other aspects of the machining occupations.

APPENDIX A

A catalogue entitled *Canadian Vocational Correspondence Courses*, available on request from the Vocational Training Branch of the Department of Labour, Ottawa, lists 123 correspondence courses in a wide variety of vocational subjects. These courses are prepared by provincial Departments of Education and are available at low cost to all residents of Canada. Courses from Quebec are in French. The catalogue contains the following courses of interest to beginning tradesmen:

No. 68. Machine Shop Practice I, Ontario—20 Lessons—Fee $10 (1954)
- Prerequisite —Grade VIII Mathematics
- Prepared for —Tradesmen
- Content —This course on benchwork covers files, filing, polishing, layout tools and their use, drilling, tapping, grinding standard threads, soldering and brazing, riveting, hammer welds, elementary heat treating, hardening and tempering.

For further information write to:
The Director,
Correspondence Branch,
Department of Education,
Toronto 5, Ontario.

No. 42. Blueprint Reading, Quebec—15 Lessons—Fee $10 (1954)
- Prerequisite —Grade IX or equivalent.
- Prepared for —Tradesmen and general public.
- Content —This course is designed to teach machinists or those interested in mechanics how to read blueprints.

For further information write to:
The Director,
Correspondence Course Bureau,
506 St. Catherine Street East,
Montreal 24, Quebec.

No. 44. Blueprint Reading, Nova Scotia—20 Lessons—Fee $12 (1943)
- Prerequisite —Grade IX or Elementary Mathematics or equivalent.
- Prepared for —Tradesmen (Metal Trades).
- Content —This course is designed to teach mechanics how to read blueprints.

For further information write to:
The Supervisor,
Correspondence Study Branch,
Box 221, Halifax, N.S.

LOCAL INFORMATION

"CANADIAN OCCUPATIONS" SERIES

Monographs and Pamphlets

The monographs listed below, accompanied by pamphlets, except in the case of numbers 11, 12, 13, 39, 42 and 43 have been published to date.

(1) Carpenter
(2) Bricklayers and Stone-Masons
(3) Plasterer
(4) Painter
(5) Plumber, Pipe Fitter and Steam Fitter
(6) Sheet-Metal Worker
(7) Electrician
(8) Machinist and Machine Operators (Metal)
(9) Printing Trades
(10) Motor Vehicle Mechanic
(11) Optometrist
(12) Social Worker
(13) Lawyer
(14) Mining Occupations
(15) Foundry Workers
(16) Technical Occupations in Radio and Electronics
(17) Forge Shop Occupations
(18) Tool and Die Makers
(19) Railway Careers

Careers in Natural Science and Engineering: (20-35, one booklet)

(20) Agricultural Scientist
(21) Architect
(22) Biologist
(23) Chemist
(24) Geologist
(25) Physicist
(26) Aeronautical Engineer
(27) ——
(28) Chemical Engineer
(29) Civil Engineer
(30) Electrical Engineer
(31) Forest Engineer and Forest Scientist
(32) Mechanical Engineer
(33) Metallurgical Engineer
(34) Mining Engineer
(35) Petroleum Engineer

(36) Hospital Workers (other than Professional)
(37) Draughtsman
(38) Welder
(39) Careers in Home Economics
(40) Occupations in the Aircraft Manufacturing Industry
(41) Careers in Construction
(42) Medical Laboratory Technologist
(43) Careers in Meteorology

Filmstrips

The Department of Labour has prepared, to date, the following occupational filmstrips in collaboration with the National Film Board. A manual has been prepared as an accompaniment to each filmstrip. These may be purchased from the National Film Board, Box 6100, Montreal, or from any one of its regional offices.

Plumber, Pipefitter and Steamfitter
Careers in the Engineering Profession
The Social Worker
Technical Occupations in Radio and Electronics
Bricklayer and Stone-Mason
Printing Trades
Careers in Natural Science
Careers in Home Economics
Motor Vehicle Mechanic
Mining Occupations
Draughtsman
Careers in Construction
Machine Shop Occupations

DEPARTMENT OF LABOUR

Economics and Research Branch

CANADA, 1958

OTTAWA
EDMOND CLOUTIER, C.M.G., O.A., D.S.P.
QUEEN'S PRINTER AND CONTROLLER OF STATIONERY

Cat. No. L43-858

CANADIAN OCCUPATIONS

★

MACHINIST and MACHINE OPERATORS (Metal)

★

MONOGRAPH 8

REVISED 1959

DEPARTMENT OF LABOUR, CANADA

CANADIAN OCCUPATIONS MONOGRAPHS

(1) Carpenter
(2) Bricklayers and Stone-Masons
(3) Plasterer
(4) Painter
(5) Plumber, Pipe Fitter and Steam Fitter
(6) Sheet-Metal Worker
(7) Electrician
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(44) Teacher
(45) Physical and Occupational Therapist.

All monographs in the CANADIAN OCCUPATIONS series are priced at 10 cents per copy, with the exception of *Careers in Natural Science and Engineering*, which is 25 cents. A discount of 25 per cent is allowed on quantities of 100 or more of the same title.

Send remittance by cheque or money order, made payable to the Receiver General of Canada to:

The Queen's Printer,

Ottawa, Canada.

CANADIAN OCCUPATIONS

★

MACHINIST and MACHINE OPERATORS

(Metal)

MONOGRAPH 8

REVISED 1959

HON. MICHAEL STARR, MINISTER

A. H. BROWN, DEPUTY MINISTER

DEPARTMENT OF LABOUR, CANADA

FOREWORD

During recent years there has been a steadily increasing demand for Canadian occupational information. This demand comes from youth faced with the need of choosing an occupation and preparing for it; from parents, teachers and vocational guidance counsellors; from workers wishing to change their occupations; from employment service officers; from personnel directors and union officials, and from other quarters.

The "Canadian Occupations" series of monographs is designed to help meet this demand. Each booklet describes, among other things, the nature of the occupation or group of occupations, entrance and training requirements, working conditions and employment outlook.

Occupational information tends to become dated as a result of changes in economic conditions, industrial technology, wage and salary structure, etc. Revision of outdated publications is a regular feature of this series, and space is left in the last few pages of each monograph for recent changes and other local information concerning the occupation.

This series has been prepared with the generous assistance of representatives of management, trade unions and professional associations. The co-operation of the Unemployment Insurance Commission, the Vocational Training Branch of the Department of Labour, and the Dominion Bureau of Statistics is gratefully acknowledged.

The present monograph was revised and written by William Allison, Chief of the Occupational Analysis Section. Acknowledgment is extended to Canadair Limited for illustrations, and to the International Association of Machinists for assistance in checking the textual material.

DIRECTOR,
Economics and Research Branch,
Department of Labour.

October 1959.

MACHINIST AND MACHINE OPERATORS (Metal)

Photo: N.F.B.

Machine shops are basic to modern industry.

HISTORY AND IMPORTANCE

We need only to look around us to appreciate the importance of metal products in our daily lives. Automobiles, locomotives, household appliances and utensils, engines, machines and tools of all kinds are composed mainly of shaped metal parts. Furthermore, practically all non-metal goods are manufactured by machines that are made of metal. Metal-working is thus an essential

part of modern industry, and calls for the skills of a variety of metal-working craftsmen, including machinists and machine operators.

The shaping of metals for his own use was one of man's early problems. The hammering of soft copper into useful articles marked the beginning of his metal-working activity. The alloying of copper with tin to make bronze involved the use of heat and led to the development of the forge, in which heated metal is pounded into shape. Another early method of shaping metal consisted of pouring the molten metal into moulds to make castings. This led to the foundry processes. When man learned how to grind and cut metals to desired shapes, the trade of the metal machinist was born.

Early methods of grinding and filing metals were laborious and crude, but several important inventions were to change metal shaping and assembly methods. These ushered in the Industrial Revolution of the 18th century and the remarkable developments in manufacturing that were to follow.

The harnessing of steam power by James Watt provided the continuous force needed to rotate a piece of metal stock against a hard cutting tool. The invention of the slide rest by Henry Maudsley, and its application to other machines besides the lathe, solved the problem of cutting metal into straight line, flat-surface, circular, cylindrical, conical and spherical shapes. This made it possible to produce the shapes for individual parts of machinery with a degree of ease, accuracy and speed not matched by the hand of the most skilled craftsman.

The third great stride toward modern production methods was contributed by Eli Whitney, an American better known, perhaps, for his invention of the cotton gin. Up until the turn of the 19th century, manufacturing was largely on a "job" basis, in which a skilled craftsman made and fitted individual parts, and assembled them to make the finished product. From his experience in making the cotton gin, Whitney conceived the idea of making interchangeable parts for muskets, which were needed in large numbers. This process made it possible to subdivide the work, a number of craftsmen turning out large numbers of individual parts, each identical to its mates. Muskets of standardized pattern, with interchangeable parts, could thus be made up in quantity. This marked the beginning of mass production, a process later to be refined by Henry Ford in the manufacture of low-priced automobiles.

Technological developments such as these had an important effect on the metal-working crafts. Before the subdivision of labour, a skilled craftsman was required to undertake, from start to finish, the manufacture of a product. The introduction of specialized machines to carry out individual steps of production permitted the employment of machine operators skilled only in one operation.

Skilled metal-working craftsmen are concentrated in highly industrialized countries, and Canada is relatively young as an industrial power. Entering the 20th century as a predominantly agricultural country, Canada emerged from World War II with the emphasis changing to industry, particularly manufacturing. This shift has resulted in an increased demand for craftsmen skilled in industrial processes, especially machinists and metal-working machine operators.

FIELD OF WORK

Machinists and machine operators work in machine shops, situated wherever mechanized industry has become established. Machine shops may be classified roughly into three different types, according to function—*job* or *custom machine shops*, *production machine shops* and *machine repair shops*—although the demarcation is not always clear, and there is often some overlap in function.

Job Machine Shops are most versatile, since they are capable of doing practically any type of metal machining within the limits of their equipment, including repair work. Their main function is to produce limited quantities (one to a few thousand) of a wide variety of metal parts made to the specific requirements of customers. They are located wherever a sufficient concentration of industry warrants their existence.

Owing to the wide variety of work in job or custom machine shops, it is to be expected that a considerable proportion of the staff would be skilled all-round machinists, capable of carrying out any type of machining likely to be required. Since production does not ordinarily run to large numbers, there is less need for the machine operator.

Production Machine Shops are usually the main departments of companies manufacturing large quantities of hard consumer goods, such as automobiles, aircraft, household appliances, typewriters,

military weapons and the like. Production shops are situated mainly in large industrial centres, such as Toronto, Hamilton, and Montreal, or in towns where a large manufacturing plant provides the main source of employment.

The large proportion of workers in these shops are machine operators, although highly skilled all-round and specialist machinists and other technical workers are required to plan, organize and set up the production processes.

Machine Repair Shops are usually attached to any factory or establishment where the need for maintenance and repair to machinery warrants the employment of one or more machinists to carry out such work. These shops are usually located within a factory or power plant, and may vary in size from a corner in the engine room to separate, well equipped departments. The nature of the work requires versatile, all-round machinists and mechanics.

Photo: N.F.B.

The machinist is a skilled craftsman.

MACHINIST

NATURE OF THE WORK

The *all-round machinist* is a highly skilled craftsman who makes or repairs parts for metal machinery and equipment, using a variety of hand and machine tools. Two outstanding characteristics of the machinist's work are the wide variety of operations that he is required to carry out, and the high degree of accuracy (tolerance) to which he must work.

He operates all the standard metal-working machine tools, such as the drill press, engine lathe, boring machine, milling machine, grinder, planer and shaper, and power hack-saw, in addition to any machines designed for special operations. He also uses a number of hand tools, including scrapers, files, scribers, micrometers and calipers. He finishes machine parts, and fits and assembles them.

The machinist's work requires a thorough knowledge of blueprint reading and job specifications, shop mathematics, machine shop practice, working properties of commonly used metals, heat treatment methods, and the use of standard bolts, threads and screws.

Specialist Machinists

Although the well qualified machinist is capable of carrying out all the operations in planning, marking out, setting up and fitting any project, many machinists—particularly those in production shops—specialize in one phase of the work. The *set-up man*, for example, may be assigned to a number of machines on which he sets up the cutting tools and adjusts the controls. After making a test run and checking the results, he turns the machine over to an operator to make the production run. The *lay-out man*, using templates, or measuring from base lines, makes marks on the metal stock before it is machined to guide the machine operator.

It is not uncommon for fully qualified machinists to specialize in the operation of a particular type of complex machine in order to earn higher wages, although in doing so, they run the risk of losing their all-round skill.

QUALIFICATIONS

Mechanical interest and aptitude are the main personal qualifications required, together with good eyesight and mental alertness. Since formal training may extend over a number of years, including evening classes or home study, the prospective machinist should be prepared to forego attractive wages in less skilled occupations in return for the long range goal of qualified craftsmanship.

PREPARATION AND TRAINING

The minimum education for young men proposing to become qualified machinists is considered to be complete public school. Many firms having formal plant training and apprenticeship programs demand at least two years of secondary school, preferably in shop subjects. It has been found that men with better than average education more readily adapt themselves to the changing requirements of technological progress.

Prospective machinists now have the opportunity for considerable preparation in the trade at the secondary school level. Many technical and vocational schools have machine shop equipment and offer practical and theoretical shop courses, including shop mathematics, physics, metallurgy, mechanical drawing, blueprint reading and machine shop practice.

Apprenticeship

The usual way to become a qualified machinist is through formal in-plant training or by serving an apprenticeship, lasting about four years. In British Columbia, Alberta and Newfoundland the machinist's trade is regulated by a provincial apprenticeship program. In Nova Scotia and New Brunswick the trade is designated for apprenticeship in certain companies. Many large plants in Canada have made their own provision for a continuing supply of qualified craftsmen by setting up well developed in-plant training programs.

The training that apprentice machinists receive varies from plant to plant, although efforts are being made to standardize it so that qualifications will be more uniform throughout the trade. In some cases beginners may be expected to "pick up" the trade skills as they work around the shop. In other plants with organized

Photo: N.F.B.

The apprentice learns from the journeyman.

training plans, training will consist of practical instruction in each department of the shop under the guidance of qualified machinists and instructors.

Apprentices usually start out by working in the tool and steel crib, learning the proper names of tools and supplies, how to operate power hack-saws and other equipment, and how to keep tool and stock records. They will be concerned with learning to read the blueprints and specifications used in the shop and they may even spend some time in the drafting office. They learn how to use precision measuring instruments such as micrometers and gauges, and to develop skill with hand tools for finishing and fitting. They become proficient with practice on the lathe and other machine tools, and learn the variety of uses to which they may be put, as well as their limitations. In time, apprentices learn how to plan individual jobs and to carry them through to completion in an efficient manner.

Those who train by apprenticeship may be required to increase their practical and theoretical knowledge by attending night classes at local technical schools. A number of useful home study courses are available to trainee machinists. Appendix A lists a few Canadian Vocational Correspondence Courses offered by provincial Departments of Education to all residents of Canada.

During training, apprentices must gradually acquire a collection of hand tools and instruments. These amount to about $250.00 in value, more or less, and the firm may assist in their purchase.

ENTRY

Students leaving school to find their first job may apply to local offices of the National Employment Service, where they will be given every assistance in locating a suitable training situation. Students graduating from secondary schools where they have received shop training may obtain assistance from the school placement officer. In provinces where the trade is designated for apprenticeship, local apprenticeship authorities should be in a position to advise prospective machinists regarding training opportunities.

Many employers use the employment columns of daily newspapers to advertise their requirements for qualified machinists and apprentices. Job-seekers may also apply directly to employing firms, and employment leads can be located in the Yellow Pages of the telephone directory under "Machine Shops", "Machinery", "Steel", etc.

Those intent on becoming well qualified machinists should select firms known to have good training programs. Application should be made as early as possible, since such firms generally have a waiting list. These firms are selective about taking on apprentices, preferring those with good educational background and vocational or technical school training. Some firms make it a practice to give preference to applicants who are recommended by their own employees, and it may be valuable, therefore, to have friends already in the trade.

WORKING CONDITIONS

Earnings

Remuneration for qualified machinists and apprentices varies widely, depending on locality, type of industry and degree of proficiency and experience.

Table 1 — HOURLY WAGE RATES FOR MACHINISTS IN SELECTED INDUSTRIES, OCTOBER 1958

	Average $	Predominant Range $
Mining		
Gold	1.53	1.38 — 1.67
Iron	2.37	2.11 — 2.62
Metal Mining (Except Gold & Iron)	2.28	1.72 — 2.67
Coal (per day)	13.59	12.98 — 16.00
Manufacturing		
Tobacco, Cigars & Cigarettes	2.22	2.02 — 2.35
Paper Products		
Paper Boxes & Containers	2.01	1.81 — 2.13
Maintenance (Pulp & Paper)	2.33	1.40 — 2.54
Iron & Steel Products		
Agricultural Implements	2.00	1.64 — 2.13
Household, Office & Store Machinery	1.83	1.65 — 2.20
Iron Castings	2.09	1.45 — 2.56
Machine Shop Products	1.92	1.50 — 2.45
Machine Tools	2.01	1.80 — 2.15
Industrial Machinery	1.91	1.45 — 2.50
Primary Iron & Steel	2.52	2.35 — 2.62
Sheet Metal Products	2.00	1.75 — 2.22
Transportation Equipment		
Aircraft & Parts	2.08	1.80 — 2.41
*Motor Vehicles	2.28	2.16 — 2.34
*Motor Vehicle Parts & Accessories	2.19	2.00 — 2.34
Railway Rolling Stock	1.90	1.84 — 2.03
Shipbuilding & Repairing	1.89	1.55 — 2.40
Electrical Apparatus & Supplies		
Heavy Electrical Machinery & Equipment	2.05	1.88 — 2.37
Radio, Television & Other Electronic Equipment	1.90	1.71 — 2.20
Refrigerators, etc.	2.05	1.62 — 2.44
Miscellaneous		
Clay Products	1.79	1.50 — 2.15
Petroleum Refining & Products	2.43	2.27 — 2.48
Acids, Alkalis & Salts	2.21	1.98 — 2.42

SOURCE: Department of Labour, Ottawa, *Wage Rates and Hours of Labour in Canada, October 1958.*

*Ontario only.

Generally speaking, apprentices in their first year receive 35 to 40 per cent of the journeyman rate. This percentage is increased at regular intervals, subject to satisfactory progress, until by the final year they receive 80 to 90 per cent of the journeyman rate. The quality of training received should be regarded as more important than the initial earnings.

The hourly wages quoted in Table 1 indicate what machinists earned in selected industries in Canada in 1958. Wage rates change rapidly. For current and local information readers are directed to inquire from local employers, union officials, or the National Employment Service.

ADVANCEMENT

After the apprentice has become a qualified machinist, advancement will depend largely on the direction of his skill, his preference

Photo: N.F.B.

Some machinists become inspectors.

to specialize, and his ability to assume added responsibility and leadership.

If he continues to develop his skill and craftsmanship, he may, with added training, become a *tool maker* or *die maker* and specialize in making the cutting tools, jigs, fixtures, stamps and dies used in the various machining operations. Eventually he may assist engineers in tool design work.

The machinist may also specialize in the operation of a single machine tool or in a special phase of machine shop work, such as set-up, lay-out or fitting.

Those with leadership qualities and the ability to organize and direct the work of others may advance to leading hand, shop foreman, master mechanic and, for the able few, to plant superintendent. Others may become inspectors and eventually chief of the inspection department. In the planning department there are opportunities to become methods analyst, time-study man or process analyst.

RELATED OCCUPATIONS

Training as a machinist opens up opportunities in many other fields, a few of which have been mentioned above. Other related trades are instrument maker, patternmaker or marine engineer.

Those with the ability to impart knowledge to others may find satisfaction as instructors of the trade in technical or trade schools. Machinists with a flair for salesmanship may become representatives for firms supplying the machine trade.

ADVANTAGES AND DISADVANTAGES

By far the largest number of machinists is employed in the manufacturing industry, and they share in the benefits and disadvantages associated with this sector of the economy. General working conditions, hours of work and wage rates have steadily improved. Health insurance schemes, holidays with pay and, in a few large plants, some form of guaranteed annual income, are some of the benefits that have resulted from union activity in manufacturing plants. Most employees are covered by Workmen's Compensation and Unemployment Insurance schemes.

The manufacturing industry is very sensitive to general economic conditions, however, and the combination of reduced consumer demand and large inventories results in cut-backs in production, with consequent lay-off of workers.

Machine shop work is not particularly strenuous, although workers are required to be on their feet much of the working day. Most modern machine shops are equipped with cranes and hoists for lifting heavy metal parts, and power equipment is used for heavy assembly jobs.

There are hazards involved in working with moving machinery, sharp cutting tools and heavy objects. Many plants employ a safety engineer whose job is to reduce to a minimum whatever hazards may develop. Protective clothing and equipment, such as goggles and steel-toed boots, and the use of rails, guards and other safety devices around machines, eliminate much of the danger of accident.

Health may be affected by metallic or grinder dust, and by the noise of machinery. Working to fine tolerances on precision jobs may result in eyestrain. Employers, however, are taking more and more precautions to protect workers from the ill effects or injury resulting from dust, eyestrain, fatigue and accidents.

Machinists are craftsmen whose skills are fundamental in an age of machinery, and they are thus one of a group of metal-workers without whom modern technology would be impossible. They may derive great satisfaction in carrying out precision work with machine and hand tools required to shape and fit the parts that keep the wheels of industry turning.

ORGANIZATIONS

Machinists may be members of their craft union, the International Association of Machinists, or of industrial unions covering all the workers in a single plant or industry, such as the United Automobile Workers.

* * *

After discussing the work of Machine Operators, the monograph covers the trends and outlook for both groups.

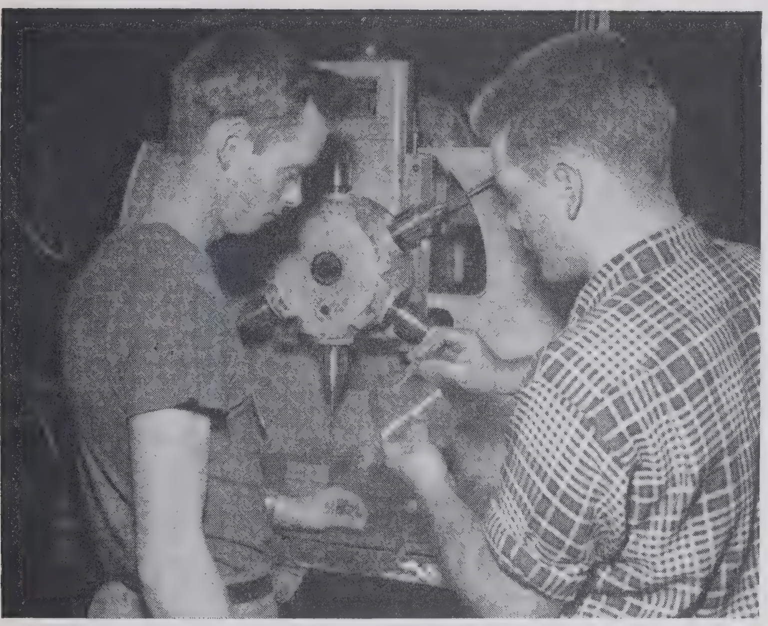

Photo: N.F.B.

The machine operator has his work set up by a machinist.

MACHINE OPERATORS
(Metal)

NATURE OF THE WORK

The *machine operator* is distinguished from the all-round machinist in the degree of skill and training required to do his job. The machine operator usually works under the direction of a machinist. He may work from blueprints or lay-outs, set up his machine for the required machining operations, adjust the feed and speed controls, and measure the work to make certain it meets specifications. He may know how to sharpen his cutting tools, and understand the machining qualities of various metals.

Indeed, the work of some machine operators may appear to be very much like that of the all-round machinist, except that it is limited to one type of machine.

The work of the majority of machine operators consists of tending or feeding a single type of machine tool that has been set up by a more skilled worker. They may make simple adjustments and check for irregularities. A feature of machine operation is the repetitive nature of the work.

Machine operators work with one of the many machines used in shops, such as engine and turret lathes, vertical and horizontal boring mills, milling machines, planers, shapers, drill presses, and precision grinders. They are often designated by the machine with which they work (e.g., milling-machine operator).

QUALIFICATIONS

An interest in and liking for machinery, a reasonably good physique, good eyesight and muscular co-ordination, and the ability to follow instructions, are necessary in this work. The noise and repetitive nature of much of the work may not be suitable for those of nervous or erratic temperament. The work usually requires the operator to stand and to have the use of both hands, although many physically handicapped persons have adapted themselves with prosthetic devices, often with dramatic results. Wartime experience demonstrated the suitability of women for many machine operation jobs.

TRAINING

Training is usually given on the job and varies with the type of machine and the degree of proficiency and responsibility expected of the worker. The skilled operator who is able to set up his machine and work independently may take one or two years to learn his job. Simple machine operation may only require a few days or weeks of training to reach efficiency.

The shop courses in many vocational or technical schools, or Arts and Crafts schools in Quebec, may assist young people in preparing for this type of work.

ENTRY

Obtaining employment as a machine operator is similar to the method outlined for machinists. First-job seekers are advised to enlist the help of the local office of the National Employment Service.

Employment as a machine operator is more casual than employment as a machinist because of the great difference in the skill and training involved. The career aspect of employment is greater for machinists than for machine operators.

ADVANCEMENT

Machine operators may advance by becoming more highly skilled and efficient in the operation of one machine, or by learning to operate another, more complex, machine. They may advance to leading hands in charge of a small group of workers operating similar types of machines and eventually become foreman in charge of all operators in a department.

Those who have taken employment as machine operator may eventually get the chance to train as apprentice machinist and the time spent as machine operator may be taken into consideration when the terms of apprenticeship are arranged.

EARNINGS

Generally, wages paid to machine operators are lower than those paid to qualified machinists in the same shop, although some operators working on a production basis may do better.

Wage rates vary across the country, as well as from industry to industry. Table 2 gives the Canadian averages for certain groups of machine operators in selected industries.

ADVANTAGES AND DISADVANTAGES

The chief advantages in machine operation are the relatively high rates of pay, including opportunity for overtime, and the relatively low training requirements. The social and economic advantages of employment in large establishments, which form a considerable proportion of all employers of this group, are worth consideration. Many of these firms have generous employee health and pension plans, paid vacations and recreational organizations. Workers are covered by Unemployment Insurance and Workmen's Compensation.

The major disadvantage of this type of work is the fluctuation in labour demand, which depends on the activity of heavy metal products manufacture. Machine operators are thus more likely to be laid off during retooling periods, or when production has temporarily exceeded demand.

Table 2 — HOURLY WAGE RATES FOR MACHINE OPERATORS IN SELECTED MANUFACTURING GROUPS, OCTOBER 1958 [1]

	Drill-Press		Punch-Press		Lathe		Milling Machine		Grinder	
	Average	Predominant Range	Average	Predominant Range	Average	Predominant Range	Average	Predominant Range	Average	Predominant Range
	$	$	$	$	$	$	$	$	$	$
Agricultural Implements	1.64	1.52-1.86	1.59	1.50-1.72	1.92	1.52-2.10	1.90	1.75-2.09	1.83	1.70-2.10
Heating and Cooking Apparatus	1.61	1.25-1.90	1.68	1.48-1.95	—	—	—	—	—	—
Household, Office and Store Machinery	1.93	1.60-2.20	—	—	1.83	1.60-2.20	—	—	1.88	1.40-2.20
Machine Shop Products	—	—	—	—	1.71	1.50-2.35	—	—	1.80	1.45-1.90
Machine Tools	—	—	—	—	1.89	1.70-2.06	1.92	1.75-2.11	1.89	1.66-2.09
Industrial Machinery	1.76	1.52-1.92	—	—	1.84	1.50-2.09	1.83	1.54-2.16	1.85	1.50-2.22
Sheet Metal Products	—	—	1.63	1.22-1.85	—	—	—	—	—	—
Aircraft and Parts	—	—	—	—	2.00	1.77-2.25	2.04	1.75-2.25	1.92	1.75-2.09
Motor Vehicle Parts and Accessories	1.96	1.76-2.07	1.90	1.70-2.31	2.05	2.00-2.19	1.97	1.62-2.39	2.03	1.92-2.19
Railway Rolling Stock	—	—	1.74	—	1.87	1.79-2.10	—	—	—	—

(1) In many cases not enough firms reported a particular group of machine operators to include in this table or to give an average or predominant range of wages.

SOURCE : Department of Labour, Ottawa, *Wage Rates and Hours of Labour in Canada*, October 1958.

TRENDS (Machinist and Machine Operators)

Number in Occupation

The number of machinists in Canada has shown a remarkable increase since 1931. It is estimated that in that year there were slightly more than 18,000. In 1941 there were approximately 25,000 and by 1951, the Census indicated that the number had grown to about 31,000. This represents an increase of about 72 per cent in the 20-year period, compared with an increase of about 23.8 per cent in the male labour force over the same period. The number of machinists in industry has therefore increased three times as fast as the male labour force.

Comparable figures are not available to show the growth of the number of machine operators during the period 1931-51. However, the Census of 1951 shows a total of 35,000.

Women in the Occupation

The number of female machinists is negligible. Wartime experience has shown that women are readily adaptable to the operation of light production machines, however, and there were nearly 4,000 female machine operators (metal) in Canada in 1951.

Age Groups

There is a significant difference between the ages of machinists and machine operators, according to the 1951 Census. At that time 21 out of every 100 machine operators were in the 14-24 age group. The comparable figure for machinists was 13 out of every 100. The greater number of young machine operators suggests that this type of work provides many entry jobs for younger workers, some of whom may later qualify as machinists.

Industrial Distribution

Although machinists and some machine operators are employed in practically every industry, they are concentrated in manufacturing. In 1951 manufacturing employed 82 out of every 100 machinists and 97 out of every 100 machine operators. The greatest concentrations were in the metal products industries, where machine operators outnumbered machinists nearly two to one. On the other hand, in non-metal manufacturing and all other industries machinists outnumbered the machine operators nearly five to one.

The Province of Ontario, being highly industrialized, accounts for 51.5 per cent of the machinists and 66.5 per cent of the machine operators in Canada; Quebec follows with 27.4 per cent and 23 per cent respectively.

Technological Change

The series of inventions and discoveries that introduced the Industrial Revolution and, incidentally, the trades of machinist and machine operators, has continued through the years. The development of new tools, processes and materials has tended to change the skill requirements for many of the metal-working trades. It is only in the last 50 years, for example, that lathe work could be carried out with any high degree of accuracy. Prior to that much of the work had to be finished by a process of precision grinding. Improved presses and dies that make possible the use of sheet-metal for the fabrication of some parts that are normally machined is another example of a change that might affect production processes.

Automation, which is a specialized aspect of technological change, may have a significant impact on the work of machinists and machine operators. The most important development in this regard is the application of automatic control devices for operating machine tools.

Automatic control involves the use of cards or tape on which are punched coded instructions governing the length, direction and depth of cuts, dimensions, tolerances, selection of cutting tools and sequence of operations. All that is required then is to feed the card or tape into the electronic control device and the machine produces the part automatically, without human intervention. This type of automation is particularly suited to short-run job shop requirements because the machine can be readily switched from job to job, and the tapes and cards can be stored for future use.

It is still too early to assess the ultimate effects of recent technological change, particularly in the metal-working industries. It is expected that the effects of automatic equipment and production processes, if widely adopted, will be toward a proportionate reduction in the need for semi-skilled machine operators and an increase in the proportion of skilled maintenance workers, including machinists.

Many machine operators will, of course, continue to be employed, but it will be increasingly important for them to have a

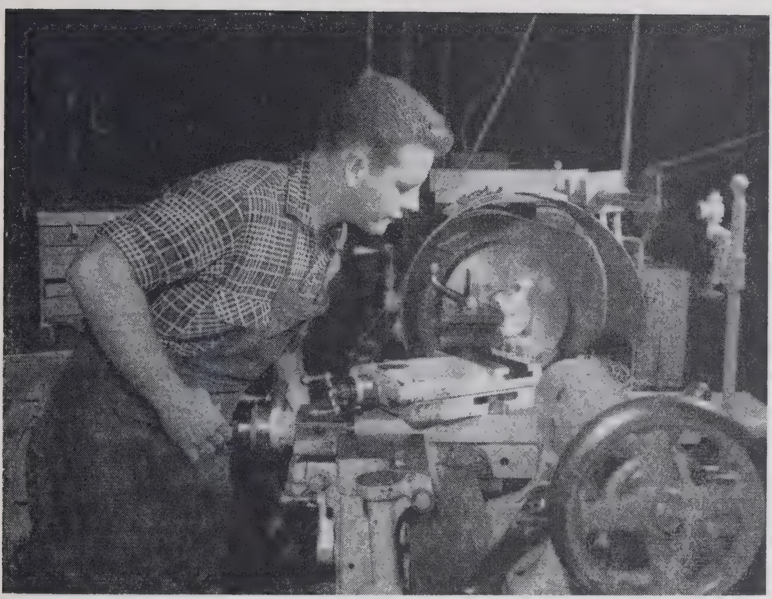

Photo: N.F.B.

The machinist may have to adapt to new production methods.

strong sense of responsibility since they will be working with very complex and expensive machines. It may also be necessary for them to have at least a rudimentary knowledge of electronics, hydraulics and pneumatics in order to understand the operation of automatic devices.

There are many factors that may limit the rapid or widespread adoption of automatic production, the main ones being the present high cost of automated equipment and the fact that automation can not be applied indiscriminately to any industry or industrial process.[1]

(1) The question of technological change and its effect on employment is far too complex to be dealt with in this monograph. For a thought-provoking treatment of the subject the reader is directed to a report entitled *Probable Effects of Increasing Mechanization In Industry,* presented by the Canadian Labour Congress to the Royal Commission on Canadian Economic Prospects. (Queen's Printer, Ottawa, Canada. $1.50)

The preliminary results of a research program being carried on by the Department of Labour, Canada, in co-operation with other agencies, is contained in Report No. 2, *Technological Changes and Skilled Manpower: Summary Report on the Electrical and Electronic Industry and the Heavy Machinery Industry,* 1957. This report is available on request from the Economics and Research Branch, Department of Labour, Ottawa, Canada.

Outlook

Machinists and machine operators are key workers in any economy based primarily on the use of metal products. The machinist's skill will never become obsolete, although it may change in character.

The number of establishments employing these workers has shown steady increase, and although employment has fluctuated sharply from time to time owing to business conditions, there is a substantial long-term growth. Because of the general economic expansion and increased industrialization expected in Canada for the next two decades, the demand for workers should remain high.

It should be readily apparent to those who are considering this work as a vocation that the qualified machinist with a good academic background will be better prepared to adapt to changes in the trade than the one whose training is narrow and specialized.

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U.S. Department of Labor, *The Occupational Outlook Handbook*, 1957, "Machining Occupations".

Canadian Labour Congress report to the Royal Commission on Canada's Economic Prospects, *Probable Effects of Increasing Mechanization in Industry*, 1956.

The Guidance Centre, University of Toronto, monograph, *Machinist*, 1956.

Yates, R. F., *Young Men and Machines*, Dodd, Mead and Company, New York, 1949.

PERIODICALS

Canadian Machinery and Manufacturing News, (Monthly), 481 University Avenue, Toronto.

The American Machinist (Monthly), McGraw-Hill Publishing Company, Inc., New York.

FILMSTRIP

The Department of Labour has collaborated with the National Film Board in producing the filmstrip *Machine Shop Occupations*, based on this monograph. It describes, with authentic pictures, the nature of the work, training, working conditions, employment outlook, and other aspects of the machining occupations.

APPENDIX A

A catalogue entitled *Canadian Vocational Correspondence Courses*, available on request from the Vocational Training Branch of the Department of Labour, Ottawa, lists 108 correspondence courses in a wide variety of vocational subjects. These courses are prepared by provincial Departments of Education and are available at low cost to all residents of Canada. Courses from Quebec are in French. The catalogue contains the following courses of interest to beginning tradesmen:

Machine Shop Practice I, Ontario — 20 Lessons — Fee \$10
Prerequisite — Grade VIII Mathematics

Machine Shop Practice II, Ontario — 20 Lessons — Fee \$10
Prerequisite — Grade VIII Mathematics

Elementary Mathematics, N.S. — 20 Lessons — Fee \$14
Prerequisite — Grade III or equivalent

Advanced Shop Mathematics, N.S. — 20 Lessons — Fee \$14
Prerequisite — Grade IX or Elementary Mathematics or equivalent.

Blueprint Reading, N.S. — 20 Lessons — Fee \$14
Prerequisite — Grade IX or Elementary Mathematics or equivalent.

Lecture de plans (éléments), (P.Q.) — 15 Lessons — Fee \$15
Prerequisite — Grade IX or equivalent.

For further information write to:

Correspondence Courses Branch,
Department of Education,
206 Huron Street,
Toronto 5, Ontario.

Correspondence Study Branch,
Box 1650, Halifax, N.S.

Service des Cours par correspondance,
506 est, rue Sainte-Catherine,
Montréal 24, (P.Q.).

LOCAL INFORMATION

CANADIAN OCCUPATIONS FILMSTRIPS

The Department of Labour has prepared, to date, the following occupational filmstrips in collaboration with the National Film Board. A manual has been prepared as an accompaniment to each filmstrip. These may be purchased from the National Film Board, Box 6100, Montreal, or from any one of its regional offices.

Plumber, Pipefitter and Steamfitter
Careers in the Engineering Profession
The Social Worker
Technical Occupations in Radio and Electronics
Bricklayer and Stone-Mason
Printing Trades
Careers in Natural Science
Careers in Home Economics
Motor Vehicle Mechanic
Mining Occupations
Draughtsman
Careers in Construction
Sheet Metal Workers
Machine Shop Occupations
Careers in Meteorology
Medical Laboratory Technologist (in colour)
Teacher (in colour)

DEPARTMENT OF LABOUR

Economics and Research Branch

CANADA, 1959

Price 10 cents Cat. No. L 43-0859
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(METAL WORKING)

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THE QUEEN'S PRINTER
OTTAWA, CANADA

Canadian Occupations
Monograph 8

METAL WORKING OCCUPATIONS

Prepared
by the
Economics and Research Branch
of the
Department of Labour, Canada

HON. ALLAN J. MacEACHEN
MINISTER

GEORGE V. HAYTHORNE
DEPUTY MINISTER

First Edition 1964

Note . . .

Information previously issued in separate booklets has been revised and included in this publication. The following titles, therefore, have been discontinued:

Sheet-Metal Worker
Machinists and Machine Operators (Metal)
Foundry Workers
Forge Shop Occupations
Tool-and-Die Maker
Welder

Available by mail from the Queen's Printer, Ottawa, and at the following Canadian Government bookshops:

OTTAWA
Daly Building, Corner Mackenzie and Rideau

TORONTO
Mackenzie Building, 36 Adelaide St. East

MONTREAL
Aeterna-Vie Building, 1182 St. Catherine St. West
or through your bookseller

A deposit copy of this publication is also available for reference in public libraries across Canada

Price 25¢ Catalogue No. L43-864
Price subject to change without notice

Roger Duhamel, F.R.S.C.
Queen's Printer and Controller of Stationery
Ottawa, Canada
1964

FOREWORD

During recent years there has been a steadily increasing demand for Canadian occupational information. The demand comes from young people faced with the need of choosing an occupation and preparing for it; from parents, teachers and vocational guidance counsellors; from workers wishing to change their occupations; from employment service officers; from personnel directors and union officials; from prospective immigrants to Canada and from other quarters.

THE CANADIAN OCCUPATIONS series of monographs is designed to help meet this demand. Each booklet describes, among other things, the nature of the occupation or groups of occupations, entrance and training requirements, working conditions and employment outlook.

The series has been prepared with the generous assistance of representatives of management, trade unions and professional associations. The co-operation of the Unemployment Insurance Commission, the Technical and Vocational Training Branch of the Department of Labour, and the Dominion Bureau of Statistics is gratefully acknowledged.

Occupational information tends to become dated as a result of changes in economic conditions, in industrial technology and in wage and salary structure. Revision of outdated publications is a regular feature of the series.

This booklet was prepared and written for the Manpower Resources Division by Alvin E. Styles and William Coe under the direction of William Allison, Head of the Occupational Analysis Section.

The branch is greatly indebted to the many organizations and companies whose assistance made this monograph possible.

J. P. FRANCIS,
Director,
Economics and Research Branch,
Department of Labour.

January 1964

CONTENTS

METAL WORKING OCCUPATIONS

HISTORY AND IMPORTANCE

Even the most casual observer will hardly have failed to notice the effects of metals on our daily lives. The food we eat, the clothes we wear, our furniture, all are processed on machines made of metals. Indeed it would be difficult to find any item which did not rely on metal in one form or another; power generation, transportation and building construction, on which all other industries depend, are themselves possible only through the use of metal machinery.

But on turning back the pages of history we find that metal working commenced when some long-forgotten Stone Age man accidentally discovered iron in the ashes of a fire built against a red paint rock. When it was discovered that this metal could be sharpened with a rough stone into perhaps a spear point, the first metal worker was in business.

Down through the centuries, many discoveries were made and there was a constant interchange between new materials, methods and appliances. To these were added improvements in simple devices especially those involving leverage and rotary movement. Further progress came with increased knowledge of mechanical principles and natural forces and the ability to produce large quantities of metals and ways of working them; thus, alloying, large-scale smelting, casting, forging, welding and other techniques evolved.

The great inventions which distinguished the 18th and 19th centuries created a new society: development of the steam engine provided vast amounts of power to replace the laborious and time-consuming methods of the hand workers; and with the coming of power machines, the seat of the industry was to move from small, craftsman-operated shops to a new centre — the metal-working plant or factory.

Of greatest importance was the effect on the workers. Up to this time, they had been required to undertake design, material selection, toolmaking, heat treatments and so on, as well as the actual shaping and cutting of metal. Machines and mechanisms demanded by the 19th century Industrial Revolution were so complex that division of metal working techniques became inevitable; for example, the smith and millwright were no longer competent to design and construct the intricate factory machinery and consequently engineers made their appearance. The increasing complexity of metal working demanded also greater knowledge of specific skills and a group called technicians emerged to specialize in, perhaps, drafting, tool design, heat treatments or planning.

On the Canadian scene the full effects of these changes were not to be felt until later; various industries develop at different times in different nations since they arise as needs demand. The blacksmith's shop had been the main site of metal working. Here were made simple implements to clear and defend the land, grow food and build habitations, the first tasks of the pioneers; products requiring the skills developed during the Industrial Revolution were usually imported. Some developments however were taking place: deposits of bog iron around Trois Rivières were to spark off a thriving local industry to cast sugar pots and weapons of war; settlers around Olinda, Ontario were also using bog iron to make their pots, stoves and potash kilns by 1830.

Canada's entry into the metal manufacturing field can perhaps be dated from the 1850's when there were vast demands for railway equipment and for agricultural implements to plow the now-accessible plains of the West. Many metal working plants opened up: plows, harrows and other implements were made at Bond Head, Ontario in 1857; blast furnaces at Hamilton and Sault Ste. Marie started to turn out steel in 1891; and an ironworks, opened at Picton in 1893, forged railway spikes, wheels and axles.

At the turn of the century, Canada began to move from a simple agricultural economy to that of an industrial nation with worldwide connections, resulting in great changes in the nation's industrial life — movement of metal working from small shops continued and many metal working plants combined to form large enterprises.

New techniques being developed elsewhere also affected Canada's metal workers. For example, the production of large quantities of standard parts became possible through mass-production methods, the assembly line, mechanical controls and, more recently, electronic and automatic controls. Production work was divided into a sequence of operations with machine setting, technical control, inspection and similar phases undertaken by different though related workers. Machines formerly operated by craftsmen could be tended by relatively unskilled workers to produce parts with a speed and accuracy never before possible.

This period typifies in many ways the changes still taking place: expanding output based on technical discoveries; increasing use of machinery and precision methods; and the introduction of techniques to reduce hand labour. These changes are demanding, and will continue to demand, an increasingly high standard of technical knowledge and skills of the workers.

It should not be thought however that all metal working is done by mass-production methods for these are not always economical unless large quantities of similar items are required. Existing alongside the production factories are small, custom and repair shops of which the general machine shop is typical. Here, using the time-honoured skills and all-round knowledge of the craftsman, small quantities of metal items are made or repaired.

In this brief history, the evolution of various groups of workers has been mentioned. Of these the production workers who make and shape metal either while liquid (moulding), plastic (forging) or cold (machining) and by fabrication are the most numerous. These are the workers about to be described in this booklet. Other booklets in this series (listed on the inside cover) describe related occupations. For example, workers concerned with the extraction of ores from the earth are described in MINING OCCUPATIONS; metallurgists and mechanical engineers in CAREERS IN ENGINEERING; and technicians in TECHNICIANS IN SCIENCE AND ENGINEERING.

FIELDS OF WORK

Metal-working occupations will be found in several different kinds of establishments ranging from small, owner-operated shops located in almost every community, to large production factories such as aircraft or automobile plants and the producers of primary iron and steel which are concentrated in Eastern Canada.

The smaller shops are known variously as jobbing shops, custom shops or repair shops. Some concentrate on the production of limited quantities of metal parts while others may specialize in repair work, but there is considerable overlap. Owing to the wide variety of jobs encountered, the employees are usually all-round workers able to undertake material selection, planning, machining, heat treatments, fitting, welding and similar techniques when required. Other shops, and these are usually small, specialize in such work as patternmaking, forging, tool-making or moulding and an all-round knowledge of the techniques used in these branches of metal working is required.

Metal workers are also employed in the repair and maintenance departments attached to paper mills, chemical plants, textile factories and other manufacturing concerns. Their main job is to keep the mechanical equipment in good order although they may install new machinery or modify that already existing. Again, all-round skills and versatility are demanded.

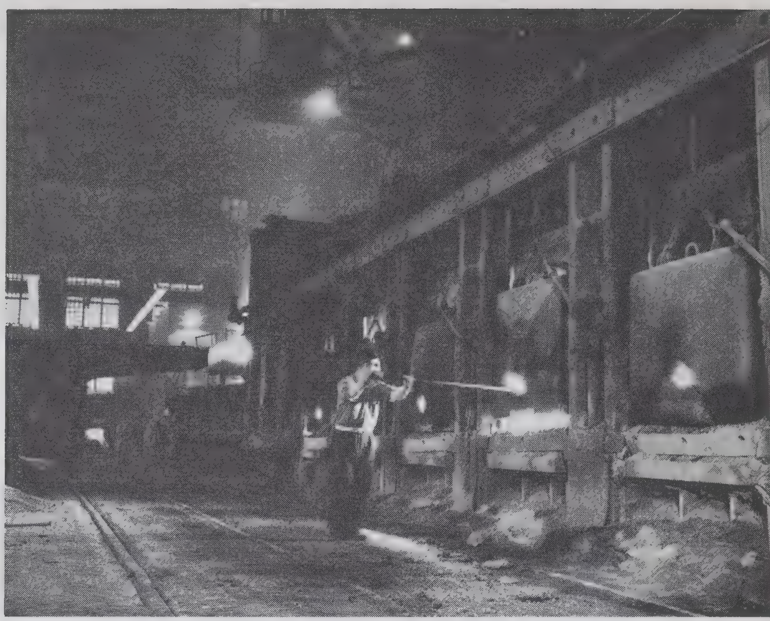
Production factories make large quantities of such metal products as agricultural machinery, household appliances and automobiles, and are located in Hamilton, Toronto, Montreal, Windsor and similar large industrial centres. In these factories much of the production is by assembly-line and mass-production methods incorporating mechanical, electronic and similar control systems; consequently workers tend to specialize in one phase of production such as machine operation, assembly or inspection.

IRON AND STEEL MAKING

The Canadian primary iron and steel industry employs a total of over 36,000 workers in a variety of jobs, many of which will be found in this industry only. Of the many plants engaged in these activities, four are completely integrated and account for over 90 per cent of the total steel produced in Canada. Integrated plants are those which reduce iron ore into pig iron in blast furnaces; convert the iron into steel; and roll, draw and form the steel into products such as bar, rod, strip, wire, and structural shapes, i.e., angles and building girders.

These integrated plants are located in Ontario at Hamilton and Sault Ste. Marie, and in Sydney, Nova Scotia with another plant projected for Montreal.

Some of the products of the integrated plants such as wire, rod and tube, can be used directly without further processing. However, other products are shipped to manufacturing concerns for fabrication. For example, strip or sheet steel is manufactured into pots, pans and automobile bodies; and rolled sections become bridges, machines and railway cars.



A steel helper stirs the contents of the blast furnace.
Photo: N.F.B. 32335

BLAST FURNACE OCCUPATIONS

Historians with lively imaginations have depicted the primitive iron worker pumping on a goatskin bellows to produce scanty blasts of air for his furnace. All early furnaces were fanned by hand bellows, for it was not until James Watt perfected the steam engine that power was available to provide a continuous blast of air. Today the blast furnace is a huge cylindrical shell, often over 100 feet tall, which provides the meeting place for the raw materials used in smelting.

Iron smelting is the work of the blast furnace crew. Raw materials such as iron ore, pellets or sinter, limestone and coke, are weighed and loaded into larry cars by *larrymen* or scale carmen. These loads are then transferred to skip cars which are hauled up an inclined track to the top of the furnace into which the materials are dumped. This may be the work of *skip tenders*

although much of this operation is now semi- or fully-automatic; the skip hoist may be driven electrically and the whole charging operation set in motion when the larryman selects a button. Some modern furnaces have conveyor belts to replace the larry cars; others have conveyor belts replacing both larry cars and skip cars.

Stove tenders are responsible for the operation of the three or four stoves usually required for a furnace. The stoves are cylindrical tanks in which blast furnace gas is burned to pre-heat an air blast before it enters the furnace. The stove tender, with the aid of the temperature recorders and automatic regulators, attempts to maintain the required blast temperature which in some plants exceeds 1,900 deg. F.

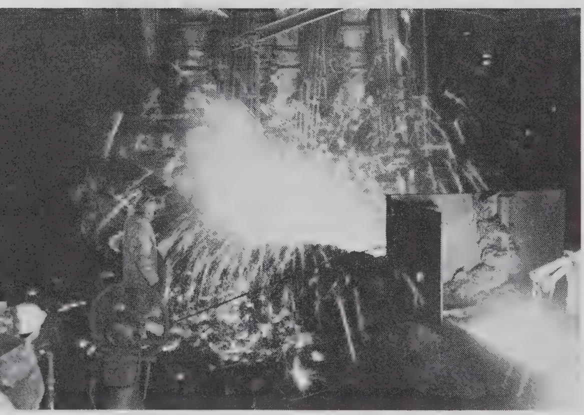
The blast air enters the furnace through tuyeres near the bottom of the furnace causing the coke to burn, gasses are generated and they, in turn, start chemical reactions. The gasses combine with the oxygen in the ore and the lime from the limestone combines with the non-metallic portion of the ore to form "slag". A *cinder snapper* (monkeyman) periodically flushes off the molten slag through a cinder notch (the monkey) into slag pits or ladles.

Blowers are responsible for the quality and quantity of iron produced. They direct smelting operations, loading and tapping of the furnace, air blasts and the furnace heat. Periodically they examine the molten metal, remove samples for laboratory tests, and make adjustments as required by laboratory reports.

About every four or five hours, *keepers* direct casting crews who drill a clay plug from the bottom of the furnace through which the molten iron flows into waiting ladles. The filled ladles are then taken by locomotive to a steel making furnace or to a pig making machine where it is cast into solid "pigs". The pigs can be later used in steel making or may go to foundries which do not make their own iron.

Drilling the tap hole of the blast furnace.
Photo: Dominion Steel

Sample of molten metal is removed from the blast furnace for analysis.
Photo: N.F.B. 32343



Pouring the molten metal.
Photo: Steel Company of Canada

STEELMAKING OCCUPATIONS

In 1860, Henry Bessemer completed a commercially satisfactory method for converting iron into steel. This was an egg-shaped receptacle called a "converter" to which an air blast was supplied through small holes in the base to burn off impurities.

This process was gradually replaced by the "open-hearth" furnace, a joint invention of C. W. Siemens in England and P. and E. Martin in France. Until recently over 90 per cent of the steel produced in Canada was by this method, the balance being produced in electric furnaces. Today, however, only about 65 per cent of Canada's total steel is produced in open-hearth furnaces. A new steelmaking process, developed in Austria and pioneered in Canada in recent years, is now accounting for approximately 30 per cent of our steel production. This is the new oxygen blown converter or basic oxygen furnace.

Modern steel making involves a complicated and large-scale chain of events starting with the blast furnace. Each step is essential to the next, and requires different groups of workers. Simply stated, steelmaking consists of reheating pig iron or hot metal received from the blast furnace until the impurities are removed. Scrap steel and, depending on the type of steel required, alloying materials such as nickel, vanadium, silicon, chromium, tungsten or manganese are then added to the molten metal.

Open Hearth Furnaces

The open-hearth furnace is a rectangular structure, so named because of the saucer-shaped floor or hearth which, unlike the blast furnace, is in view of the workers. Oil or gas is used as fuel and is admitted through the ends of the furnace. Heated air is blown along with the fuel into the furnace to aid combustion and the refining process. Oxygen lancing through the roof is now a regular practice to increase production.

In charge of a group of open hearth furnaces is the *melter* who is responsible for the quality of steel produced. Assisting the melter are first, second and third *helpers* who direct the loading of materials into the furnace, regulate the furnace heat, and take samples for quality control tests.

Boxes of cold scrap steel and limestone are fed with a mechanical charger controlled by a *charging-machine operator* through a door in the furnace. When the scrap has melted, a *molten-metal crane-man,* using an overhead crane, picks up a ladle of molten iron and pours the contents through a chute held in the furnace door.

In the intense heat of the furnace, up to 3000 deg. F., chemical reactions take place and unwanted elements in the iron either pass off as gas or combine with the limestone to form slag. At the end of six to nine hours, depending on the size of the furnace, samples are taken by the melter and alloying materials added to give the batch or "heat" the desired qualities.

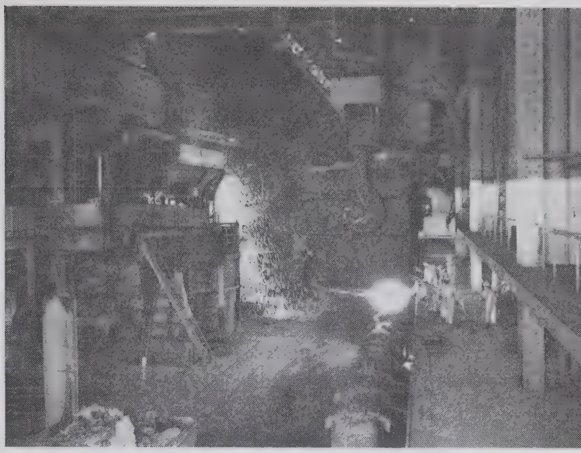
When this has been achieved, *melter's helpers*, using a jet tapper, explode a plug out of the furnace and allow the molten steel to flow into a waiting ladle. A *ladle craneman* then lifts the ladle and moves it over waiting ingot moulds where a *steel pourer* removes a stopper from the bottom of the ladle and the steel is poured ("teemed" the steel men call it) into moulds or into a continuous casting machine. When the steel has cooled sufficiently, the moulds are removed from the ingots by an *ingot stripper* who operates a crane with a special plunger attachment.

Pneumatic Converters

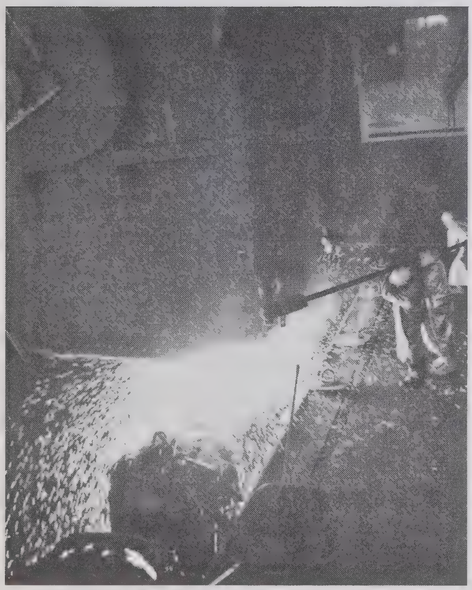
Both the Bessemer converter and the oxygen converter make steel in smaller batches but in only a fraction of the time required by the open-hearth method.

The oxygen furnace is a tilting pear-shaped vessel with an open top through which it is charged with scrap steel, molten iron and a little lime. High purity oxygen is blown down a tube or "lance" at supersonic speed onto the top of the charge which is oxidized and unwanted elements are blown off. To empty the contents, the vessel is tilted.

In both processes, occupations are much the same as those in open-hearth work. *Melters* determine the composition of the charge; *first helpers* supervise and decide when the charge is ready for pouring; and helpers, crane drivers and labourers perform loading and similar jobs.



Molten steel is poured into waiting ingot moulds.
Photo: N.F.B. 63-1938



Teeming the ladle into 17-ton capacity ingot moulds.
Photo: N.F.B. 63-1941

"Push-button" methods of teeming steel requires less physical effort than other methods.
Photo: Dominion Steel

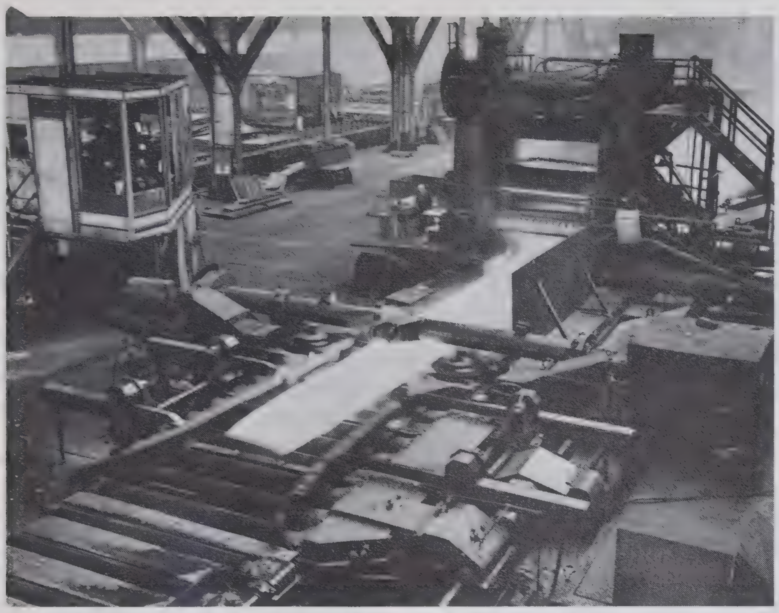
Electric Furnaces

Steels of high alloy content, such as those used for cutting tools and springs, stainless steels and other alloys are usually produced in electric furnaces where melting and refining can be closely controlled. Unlike the open hearth, which may use up to 70 per cent of iron from the blast furnace, the electric furnace uses cold scrap steel.

There are two types of electric furnace either of which produces steel in a similar manner: the furnace is charged; electricity is used to generate heat; impurities are separated; and alloying materials are added to the molten metal.

The electric arc furnace is the most common and is controlled by a team of *melters* or operators. It is a basin-shaped vessel equipped with a lid in which three carbon electrodes are inserted. The furnace is charged and the electrodes lowered until they nearly touch the steel. When an electric current is passed, an arc forms between the electrodes and the steel to generate heat. The heat melts the charge and impurities are separated into the slag. After the alloying materials have been added, the furnace is tilted and the contents tapped into a ladle; from the ladle, the steel is poured into moulds.

Special steels are also made in an electric induction furnace. The processes involved are similar to those of the electric arc, only the method of heating is different. Heating is accomplished by passing an electric current through a wire coiled round the furnace. This type of furnace usually has a capacity of less than one ton and requires only one man for its operation.



White-hot steel plates pass through this giant press in the plate mill. Control room can be seen on the left. Photo: N.F.B. 32377

ROLLING AND FINISHING OCCUPATIONS

There are three principal methods of finishing steel: rolling in finishing mills; casting in foundries; and forging metal (pounding into shape).

About 15 per cent of the steel industry's output is diverted to other mills for casting or forging; the remainder is rolled into various forms. These may be workable shapes and sizes known as "blooms", "slabs" and "billets"; semi-finished products such as plate, strip and sheet; structural sections or railroad spikes, bolts, nails and other finished products.

The "blooming" mill where heated ingots are passed through heavy rollers rather like a giant clothes wringer is typical of rolling and finishing operations.

Ingots which were left to cool so that the moulds could be removed, have to be reheated to a uniform temperature. This is done in a soaking pit, a sunken structure with automatic instruments

and controlled by a *heater*. He directs helpers in heating the metal and, by various tests, decides when the ingot is ready for rolling.

Next, a *soaking-pit craneman* lifts the heated ingot and places it on a carriage by which it is conveyed to the rolling mill. Ingots are usually rolled in the blooming mill into lighter sections of simple shapes—round, square and rectangular. In some cases, however, ingots may be rolled into finished products.

In charge of the rolling mill is the *roller* who is seated in a glass-enclosed "pulpit" above the roller line. He and his assistants control the space between the rollers and the speed and direction of the ingots, using a system of levers and switches. In some mills, a punched card system is used. The punched card containing information as to temperature, size and weight of the incoming ingot and other necessary information to regulate the rolling, is inserted by an *automatic rolling mill attendant* into a control machine. When the ingot reaches the rolling mill, the attendant selects the required controls and rolling is carried out automatically.

The steel next goes to other finishing mills where it is either turned into stock shapes or into special shapes to order. Some finishing mills are operated in the same way as the mill described earlier. In others there is a mixture of hand and remote control; here the rolling is still controlled from the pulpit but the steel is handled by *roughers* who grip the red-hot steel pieces as they come through the rollers and bring them back for the next "pass" through the rollers.

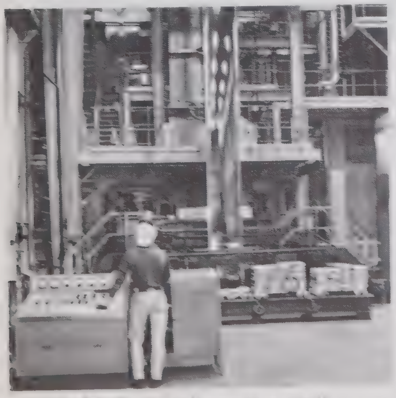
There are other occupations which, because of space limitations, can only be mentioned briefly. For example, furnacemen keep the reheating furnaces to the correct temperature; inspectors check the quality of the finished product; shearmen and saw operators cut the steel to length; and there are those concerned with tinplate making, galvanizing, wire drawing and tube making.

Blooms are removed from the soaking pit.
Photo: Stelco

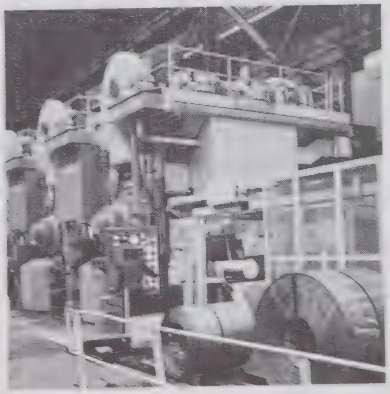
Rolling a bloom in the blooming mill.
Photo: Stelco

White-hot blooms are rolled into finished cross sections of rails.
Photo: Dominion Steel

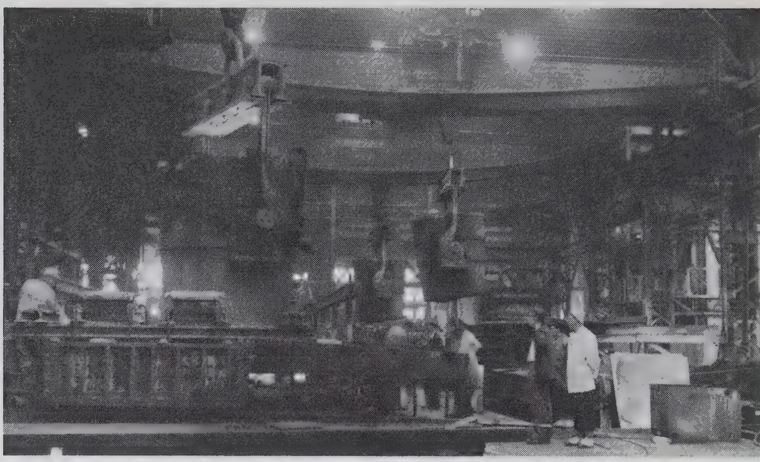
The control panel of a continuous annealing machine.
Photo: Stelco



This is a galvanizing unit.
Photo: Stelco



A cold rolling mill.
Photo: Stelco



General view of the foundry floor.

Photo: N.F.B.

FOUNDRIES

Established in Trois Rivières in 1737, the "Forges des St. Maurice" was the first foundry in Canada to cast metallic objects by pouring molten metal into a mould. It operated for over a century—even exporting castings—until the ore supply was exhausted. Foundries such as the Normandale foundry in Norfolk County, Ontario and the New Glasgow plant in Nova Scotia were typical of the nineteenth century pioneers producing castings. It was from these small beginnings that the industry has grown; today there are over 400 foundries and casting is one of the principal methods of metal working.

Where and why are castings used? There is hardly a single commodity which does not rely on castings in one form or another. The machines used to print this booklet and to make the paper on which it is printed, and the turbine which produced the electric power to drive the printing machine, all these are assemblies of castings. Other familiar uses are automobile engine blocks, cooking utensils and even the tap on the kitchen sink.

To answer the "why" part of the question: castings are used where other methods such as stamping, rolling, forging and machining would be too costly or, with some of the newer alloys, would even be impossible.

NATURE OF WORK

Foundries tend to specialize in a particular metal since different methods and equipment are required and they can be considered as being in the following groups: (a) ferrous metals—iron and steel and (b) non-ferrous metals—aluminum, brass, bronze, etc. It may be mentioned that in many occupations workers can transfer from foundries using one type of metal to foundries using a different type with very little additional training.

In general, foundry work consists of melting metal in a furnace and pouring it into a mould shaped according to a pattern. When the casting has solidified it is taken from the mould, excess metal is removed and the casting is smoothed and finished as necessary.

Depending on the size of the foundry and its operations, various groups of technical personnel are concerned with the qualities and properties of the castings and the materials used in the processes.

Large establishments may have a laboratory staffed with foundry chemists, metallurgists and technicians; smaller foundries use the services of consultants as required and employ technicians in laboratory functions.

The technical staff has varied duties. They undertake chemical analyses of metals and their alloys; test the physical properties of the casting; specify mixtures of coke, limestone and metal; specify heat treatments; and undertake microscopic, magnetic particle, X-ray and similar tests. Other duties include research and development of sand and similar moulding materials and tests to determine compression, tensile strength, moisture content and permeability.

There are several principal methods of casting, the main difference being in the kind of mould used. "Green-sand" casting, by far the most common, is where a sand mixture is packed into a container (a "flask"), around a pattern of the item to be cast. The pat-

tern is withdrawn and molten metal poured into the mould cavity to form the desired shape. The sand mould can only be used once.

Many different metals and their alloys are also cast, all of which require special techniques. For ease of understanding, specialized methods of casting are ignored in the following paragraphs and the description will be confined to sand casting, the method by which the great tonnage of gray-iron, malleable iron, steel and non-ferrous castings are produced.

Patternmaking

The first step in the production of any casting is the design and construction of a pattern—a replica of the item to be cast—and core boxes which give the casting the desired internal shape. Usually patterns are of wood—a material which is cheap and easily worked—although other materials may be used such as plastic, metal or plaster.

From the engineering drawings of the proposed casting, the *patternmaker* considers several factors: selection of suitable timber to withstand robust handling; the most economical pattern for the job in hand; standards of accuracy demanded; and the metal shrinkage which will occur when the casting is cooled to room temperatures. Then using woodworking tools, the patternmaker marks and cuts the wood and shapes the required pieces. Next he finishes the parts and assembles them into the complete unit. Finally, he gives the unit a protective coating.

Patterns of plastic, plaster and similar materials are usually prepared from a master pattern made of wood. In metal patternmaking, a rough casting or metal stock is used. From the rough casting, a metal patternmaker (or a machinist) shapes the required parts using machine tools such as the lathe, grinder or shaper, or hand files and scrapers. The parts are then brazed, welded or screwed into a single assembly, checked with precision measuring instruments and finished by filing, scraping and polishing.

Coremaking

Although the pattern will give the external shape to the casting, the interior has to be formed by a core—a body of sand designed to create the internal cavities or to facilitate removal of intricate shapes from the mould. Their production may be by hand—these are usually complex shapes—or by machine. In hand operation, the *coremaker* tamps a mixture of sand, oil, clay and other materials prepared by a *sand mixer* or *sand cutter* into a box which gives the required shape to the core. Whatever the form of the core, it is important for the coremaker to tamp the sand correctly since the density of the sand, and hence its correct functioning, depends on this operation.

Cores are baked in an oven by a *core-oven tender* to provide sufficient hardness and strength to resist the flow of molten metal which will be poured around them. On older types of ovens where temperatures are controlled manually, considerable judgment is required of the tender; modern ovens, however, have automatic controls. Where the volume of work does not justify a full-time tender, baking may be undertaken by the coremaker.

Complex cores can be baked in sections and then assembled to form the complete core unit. A *core paster* has the job of joining various sections together, filling and smoothing the joints and checking the final dimensions against jigs or templates.

An interesting development has taken place in the development of coremaking. Cores have been produced for some time by core-blowing machines in which the sand mixture is injected into the core boxes (or moulds) by air pressure. Machines are also used to make shell-type (hollow) cores from resin-bonded sands. A combined hardening agent and binder is added to the sand and, instead of baking in an oven, carbon dioxide gas or acid is introduced into the core box to harden the sand mixture.

Moulding

Moulding is the most characteristic of all foundry work for it is the moulder's skill which determines, to a large extent, the quality of the final casting. Sand moulds are the most common and it is these which will be described. They may be made by hand or machine, depending on the kind of casting, its size and quantity required.

The first step in moulding is the preparation of mixtures of sand, clay, water and binding materials and this is done by the *sand mixer*. In many plants, the sand mixer requires considerable judgment in assessing the properties of the sand he mixes. To an increasing extent, however, scientific sand-testing methods are employed and strict laboratory control is exercised.

Small moulds, for castings up to about 25 pounds, are made on the bench. The *bench moulder* fits a pattern prepared by the patternmaker into a "flask". This is a container made in two sections so that the pattern can later be removed—the top half or "cope" and the bottom half or "drag". Using a rammer and a riddle (sieve), the moulder packs sand mixture around the pattern which has been placed in the drag. He then places the cope over the drag and completes packing sand around the pattern. The flask is opened and when the pattern is removed, the sand in each section bears the imprint of the pattern. The cores, if any, are then secured in position where hollow spaces are wanted and vents are inserted to provide chambers for pouring and for the escape of gas. The cope is then placed on the drag, clamped, and the flask positioned ready to receive the molten metal.

Duties of the floor moulder are similar except, as the name indicates, moulds are constructed on the floor because of their large size. Sand may be rammed into the flask by hand but usually this is a machine operation. In addition, the heavy cope and drag flasks are handled by a crane operator.

Many foundries are now highly mechanized; moulds are made by machine and moulding mixtures are delivered by overhead conveyor. In these foundries, machine operators control various

machines, either hand or power-driven, to produce large quantities of identical mouldings. Their duties are similar to those of the hand moulder in that they assemble the pattern in the flask and compact sand around the pattern. The *machine moulder* may control the machines which fill the flask, withdraw the pattern and position the cope on the drag after the cores have been inserted. Alternatively, these operations may be divided between a job setter who sets up the machines and patterns, and a close-up man who operates the hoist to position the cope on the drag. In some highly mechanized shops, the moulding machinery may be operated automatically.

Castings may be poured by the moulders, or at least they may direct and assist in this operation. On the other hand, in plants which are highly mechanized and there is a division of labour, moulds may be filled with molten metal by *pourers*.

Melting and Pouring

Various types of furnaces are used to melt metal. These include the furnaces described earlier in the booklet, such as open-hearths used to melt large quantities of steel, electric furnaces which provide the controlled atmospheric and slag conditions required by certain alloys, and the basic oxygen furnace. There are also tilting furnaces, commonly used for non-ferrous metals, and the crucible where small quantities are needed. The cupola furnace is widely used to melt iron and scrap metal and is selected for description since it is typical of melting and pouring operations.

Coke, limestone, scrap metal and iron, in quantities determined by a metallurgist, are brought to the furnace in wheelbarrows, trucks or light railcars. These materials are then shovelled by hand or fed by charging machine through the charger door of the furnace by a *cupola charger,* or dumped from a skip hoist into the top of the cupola.

Responsible for the furnace is the *cupola tender* who supervises or, in smaller foundries, assists in the charging of the cupola. Once the "heat" is on, he regulates the air blast which fans the furnace

and, from time to time, draws off the slag. When the level of molten metal is high enough, he taps the furnace by poking out a plug (the "bott") from the spout (the "tap hole") which permits the molten metal to flow into a waiting ladle.

Pouring may be done by the *ladleman*, by a pourer or, as previously mentioned, by the moulder. This consists of tilting the ladle or transferring its contents into smaller ladles from which it is poured over a lip into the waiting mould.

Cleaning and Finishing

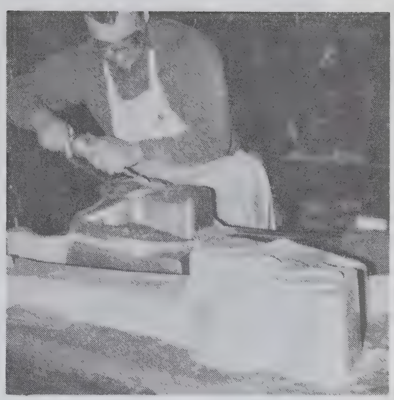
When the casting is cool enough to handle, the *casting cleaner* may undertake a variety of duties including removal of cores from the casting, cutting off extra metal known as gates and risers, cleaning off adhering sand and removing excess metal and blemishes.

In other foundries the work may be highly specialized: *shake-out men* remove the castings from the moulds and clean them by hand or vibrating machine; *burners* follow drawings and cut away excess metal and projections with oxyacetylene and other flame-cutting equipment; and *chippers* and *grinders* continue the cleaning and remove excess metal with hammers, chisels and grinders. Where a particular finish is required, *sand blasters* direct blasts of compressed air mixed with sand and other abrasives onto the casting; steel shot may also be used by a wheelabrator operator.

Some castings undergo further processing and must be heated and cooled under controlled conditions to change their physical properties. The *annealer* loads the castings into a furnace and by observing pyrometers and other instruments maintains the desired temperatures.

Inspectors may be stationed at various points to check the castings. They use a variety of gauges and similar aids to check dimensions; surface defects are usually recognized by visual inspection, while smaller defects or sub-surface faults require the use of X-ray machines and similar equipment.

The patternmaker and apprentice.
Photo: N.F.B.



The metal patternmaker grinds a pattern to shape.
Photo: Hawker-Siddeley

Preparing cores on a core blowing machine.
Photo: Hawker-Siddeley

Cores entering the drying oven.
Photo: Hawker-Siddeley

Assembling a casting in a floor pit.
Photo: Hawker-Siddeley

Pouring molten metal into a floor mould.
Photo: N.F.B.

The blacksmith is an all-round craftsman.
Photo: N.F.B. 44715

FORGE SHOPS

Early settlers tilled the soil of the New World with heavy plows and harrows and harvested their crops with sickles and scythes, implements which were made in the forge by the blacksmith using basic tools—the anvil, hammer and his bellows forge.

With the advent of industrialization, machine power began to take the place of the blacksmith's right arm. Mechanical hammers, heavy presses and new metals increased the number, size and variety of forgings produced. Other technical improvements have been and are continually being made until today the forge shop makes products in hundreds of alloys and with equipment which ranges all the way from simple hand tools to power-driven hammers capable of striking metal many times per minute, and mighty presses which can exert a squeeze exceeding 50,000 pounds.

Basically however the forging process is the same as it was in early times: metal stock is heated in a forge and, while plastic, pounded and squeezed into shape. The major advantage of forging is that the grain of the metal is retained, i.e., the crystals lie in the same direction. This gives the finished product a high degree of strength, durability and a long working life, qualities which are necessary in items such as machine parts and power tools.

NATURE OF WORK

The practice of identifying metal workers with the metal they used has resulted in a number of occupational titles such as goldsmith, silversmith, coppersmith and tinsmith. The original forge shop worker became known as the blacksmith because he made his wares out of iron—the "black" metal. The expansion of industry and use of special machines for forge work permitted a subdivision of labour that was not formerly possible, and created the need for new skills and several new classes of workers. In modern forge shops, workers are identified with the machine they operate or the process they carry out, and are further classified according to their skill.

Duties of forge shop workers are affected by the size of forgings made, degree of mechanization in the shop, and the type of forging process. To understand the work involved in forging it is useful to consider first the duties of the all-round blacksmith who accomplishes on a small scale, using hand tools, that which production shops accomplish on a large scale, using special machines and employing many workers.

Hand Forging

The *blacksmith* forges and repairs metal parts used in farm machinery, and in industrial and domestic equipment. He may also make, sharpen or harden drills, chisels and other tools, undertake custom work such as ornamental railings, and offer services such as forge welding (heating separate parts and hammering them together), and oxyacetylene and electric-arc welding services; a few shoe horses. Blacksmiths may be self-employed although a number work in the repair and maintenance departments of industrial enterprises.

In making a new product, the duties of the blacksmith are typical of all forge shop work: metal is heated in a forge; while it is still hot and plastic, it is hammered into shape; and is finished by tempering, hardening and grinding.

Planning is the first step and this consists of making sketches from oral and written instructions, although some customers may supply drawings which the blacksmith is required to read and interpret. He will decide what forming tools are needed—often he will design and forge special tools for the work in hand. Next, he will estimate the amount of metal stock required and may advise of the most suitable metal for the job. He will then ensure that all tools are readily available.

Heating the metal is the next step. The blacksmith places the stock in his forge and, by controlling the amount of air pumped by the forge bellows, it is heated to the working temperature. Usually the blacksmith judges the temperature by observing colour changes in the metal although instruments such as temperature-recording pyrometers may be used. Heating metal is a highly skilled art requiring considerable judgment—different metals have distinct working temperatures and can be burned or heated too quickly, causing scale to form.

Next, the heated metal is placed on an anvil. The blacksmith holds a forming tool in one hand and pounds the metal with a hammer held in the other hand. Frequently, however, he holds the metal and the hammer is swung by a *blacksmith's helper* or by an apprentice. As the metal is being shaped it is carefully watched for any colour changes which indicate that the metal must be reheated.

The changes to be made in the stock determine the type of tool that will be used. "Flatters" are used to flatten and smooth the work, "fullers" to form rounded grooves, and "swages", which are made in two parts, are used to make round pieces. Holes are made with punches and enlarged with "drifts". Shaped parts are cut away from the rest of the stock with "sets".

Although he uses measuring devices such as calipers, rulers and templates, to check the dimensions of the article he is shaping under the hammer, a blacksmith does much of the necessary measuring by sight alone. For this reason, he must have a good eye for shape and size.

In some cases, the shop may be equipped with a small drop-hammer which the blacksmith uses to forge articles too large for his anvil and hammer.

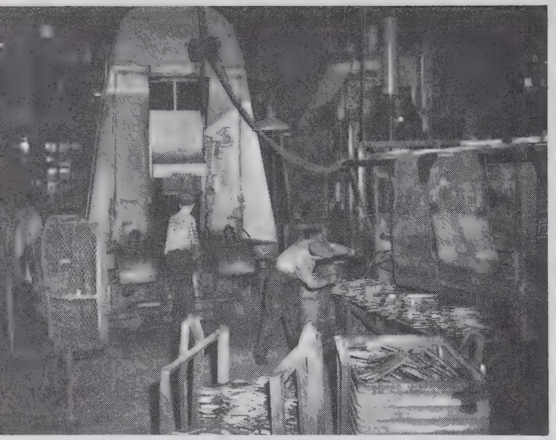
After the item has been formed, the blacksmith may heat treat the metal to bring it back to the correct temper or hardness. In tempering—the process of making metal tougher and less brittle—the metal is heated and kept at a high temperature for a specified time and then allowed to cool gradually. To harden tools, they are heated and quickly cooled (quenched) by plunging them into an oil or water bath. Finally, the item is ground and otherwise finished to remove any imperfections.

Machine Forging

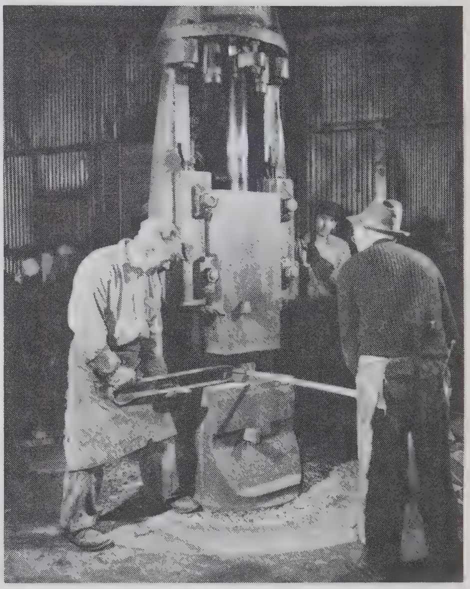
The production forge shop is an expansion of the original blacksmith's shop, with much of the equipment mechanized and a subdivision of labour. Forge shop work divides roughly into two main types of operation—*heavy forging* and *drop-forging*.

Heavy forging is done by a crew of men working as a unit at a power-driven hammer equipped with open (or flat) dies. The force of the blow delivered by this hammer is controlled by the operator and can be varied according to the impact required. The jobs handled in this type of work are usually the larger ones requiring less need for working to close tolerances. Large-scale bending and forming is done to obtain gross shapes which are then finished to more accurate dimensions by chipping and grinding. Some of the workers require skills and knowledge similar to the blacksmith's, as well as the ability to direct a number of workmen in close crew work.

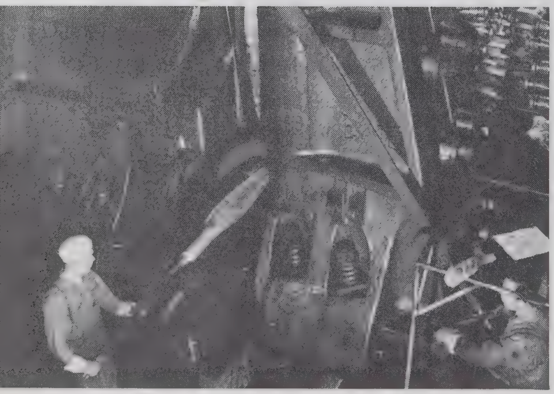
The *hammersmith*, called *hammerman* in some shops and *forge crew leader* in others, is the key worker. He must be able to read and work from drawings or specifications, have a knowledge of shop mathematics and be familiar with the principles of forging and the properties of metals. He is in charge of the operation of the hammer and directs the work of the crew, which may consist of a hammer driver, a heater and one or more helpers.



Blanks heated in the furnace at rig are formed into plow shovels on t forge hammer.
Photo: International Harvester



The drop hammer operators work as a team.
Photo: N.F.B. 39384



In the forge shop, this 21-ton hamm forms aluminum blades.
Photo: N.F.B.

The hammersmith supervises the heating of the metal, frequently checking the temperature with a pyrometer or by observing colour changes. He directs the helpers in removing the metal from the forge and transporting it to the anvil plate of the hammer. This usually involves mechanical aids such as an overhead chain hoist. With hand signals or verbal instructions, the hammersmith directs the helpers in positioning and manipulating the stock, and indicates to the hammer driver the force and number of blows necessary to shape the heated metal.

Supervising the cutting and trimming of forgings and checking the dimensions of finished forgings with calipers, squares or other measuring devices are also part of the hammersmith's work.

The *hammer driver* is an assistant operator. Working under the direction of the hammersmith, he manipulates the controls of the hammer to regulate its stroke and thus govern the force of the blow.

Drop forging is usually done on a hammer equipped with closed (shaped) dies which, when brought together accurately, form a mould. The top half of the die is attached to the ram of the hammer; the bottom half is positioned on the bed of the hammer. The ram is raised by steam, air or other source of power and, when released, drops under its own weight, bringing the dies together with constant force. The jobs handled in drop forging are usually smaller than those of heavy forging and are carried out to much closer tolerances. With a diversification of labour and the use of a variety of machines, forgings are passed from worker to worker on a production-line basis.

Drop-hammer operators position and manipulate the heated metal on the bottom half of the die and operate the controls of the hammer to strike the number of blows required to shape the metal. If the work is being hot-trimmed, they transfer the shaped part to a trimming press and, placing it in a cutting die, operate that machine to trim the work. Drop-hammer operators may be responsible for setting the dies in their machine, or it may be done by a *set-up man.*

One phase of drop forging not usually found in heavy forging is the making of closed dies used in the hammers. There is a great deal of skilled work involved in the laying out of the die, die sinking, the use of automatic die-copying machines for contour forming, and the hand finishing and polishing of dies. A number of skilled workers are also engaged in die repair work. The occupation of tool and die maker is described on page 47.

In all types of forging, various workers assist the hammersmiths or drop-hammer operators, or to carry out special forging operations.

Heaters, under the direction of operators, prepare metal stock for shaping by placing it in a forge and heating it to the correct working temperature at the correct rate. With the aid of helpers, they remove heated stock from the forge and transport it to the anvil. Should the metal cool before forging has been completed, it is returned to the fire for reheating.

Forge-press operators are in charge of forging machines which shape metal through the exertion of force in the form of a slow squeeze rather than as a striking blow. They place heated metal in the die and operate the controls of the machine to press the metal into shape.

Upsetters operate forging machines equipped with closed dies that move in a horizontal direction. They are responsible for directing the work of the heater and helpers assigned to their press and also for adjusting the pressure of the machine.

Other workers are employed in cleaning and finishing. *Trimmers* remove excess metal from forgings with a saw or trimming press, and are responsible for setting the dies in their machine; *chippers* and *grinders* use hand hammers, chisels and abrasive wheels to smooth off surplus metal and imperfections; *blasters* clean the forgings with shot blasting machines—in some shops, blasts of steam are being used; *picklers* remove scale by dipping the forgings into an acid bath, and *heat treaters* alter the physical properties of forgings to produce a specified degree of hardness and strength. *Inspectors* check the size, quality and temper of finished forgings.

Not all machine shops are as large as this complete service and repair facility at Sidney, Nova Scotia.

Photo: Dominion Steel

MACHINING AND RELATED PROCESSES

Until the 17th century, craftsmen made articles of iron, brass, copper or other metals by beating them into shape with hammers, carving them with chisels, files and scrapers, or grinding them with hand-powered grinders.

About 200 years ago steam was harnessed to furnish the continuous power needed to rotate a piece of metal stock against a hard cutting tool. This, together with the invention of the slide rest and its application to other machines besides the lathe, solved the problem of cutting metal into straight line, flat surface, circular, cylindrical, conical and spherical shapes. Thus it became possible to produce the shapes for individual parts of machinery with a degree of ease, accuracy and speed not matched by the hand of the most skilled craftsman.

Manufacturing up until the turn of the nineteenth century was largely on a "job" basis, in which a skilled craftsman made and fitted individual parts and assembled them to make the finished product. When the idea of interchangeable parts was conceived, it became possible to subdivide the work, a number of craftsmen turning out large numbers of individual parts, each identical to its mates. This marked the beginning of mass production and the introduction of specialized machines to carry out the individual steps of production.

All these developments have affected the workers engaged in shaping metal parts, or "machining", as it is now called. First, there are all-round machinists or journeymen who, through a well-rounded training, are capable of doing most of the jobs in a machine shop. There are also many specialists who have become expert in the use of a particular machine, or in carrying out a particular operation. In addition, many machines, especially in large production shops, are automatic or semi-automatic and once set for a production run, need only be worked by a machine operator or tender.

Development of improved types of machine tools continues, making more and more use of automatic control or new production techniques. A few of these will now be mentioned briefly since the increasing use of these methods is affecting the skill requirements of machinists and machine tool operators.

Automatic controls make it possible to program or predetermine an entire production sequence on magnetic tape or punched cards which the machine can carry out automatically; many hand operations such as machine setting are eliminated and the machine operator, to control the machine, is required merely to change the card or tape.

Again to eliminate hand work, copying, duplicating and tracing methods are used. In these processes, a stylus follows the outline of a master model or template made by a highly skilled toolmaker. As the stylus moves around a curve or angle in the model, the movement is transmitted through a pneumatic, hydraulic or electronic servo-mechanism to the cutting tool. Thus, an exact copy is reproduced and hand operations, with the exception of speeds and feeds, are not required.

Present experiments indicate the future practicality of working out mathematical models of desired metal parts which may be produced without resorting to engineering drawings and their interpretation by a skilled craftsman. Instead, the mathematical model, worked out by an engineer or technician, is fed to an automatic machine which translates the mathematical instructions into the sequence of cutting operations needed to shape the metal part.

While such developments point toward the future in the machine shop, the skills and knowledge of present-day machinists and machine operators are likely to be needed for a long time to come.

MACHINING—CUSTOM AND REPAIR WORK

To repair and maintain machines and mechanical equipment, or to produce limited quantities of metal parts (perhaps of unconventional design), requires the services of craftsmen with two outstanding characteristics: (1) above-average manual skills plus the ability to operate a wide variety of machine tools to very close limits of accuracy and (2) a sound knowledge of the theory underlying these operations. These characteristics are required to work out the many problems which arise on all new projects and to effect repairs as quickly as possible.

A carefully regulated period of training and education is required to develop these characteristics and, for this reason, custom and repair work is undertaken by craftsmen who have served an apprenticeship (full details of apprenticeship are given in the section dealing with Preparation and Training).

Depending on the branch of the industry and the kind of work performed, the craftsman may be known as an experimental machinist, model machinist, maintenance mechanic, industrial maintenance machinist or machine repairman. However, since the work and training are similar, these occupations will be grouped under the title *all-round machinists* for description in the following paragraphs. It may be mentioned that the work of toolmakers, instrument makers and metal patternmakers described elsewhere in this booklet is similar in many respects to that of the all-round machinists and may, in some plants, be an extension of the machinist's work.

All-round machinists are required to select materials and plan their own sequence of operations. They set and operate machine tools such as the lathe, drill press, milling machine, planer, grinder and shaper in addition to machines designed for special purposes. Using files, scrapers and other hand tools they fit and assemble metal parts and, to ensure accuracy, they use measuring instruments such as micrometers, verniers, calipers, gauges and scales.

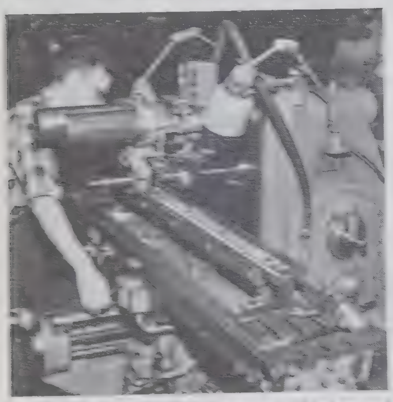
Their work requires the ability to read and interpret sketches and engineering drawings; a sound knowledge of shop mathematics; an understanding of machine tool theory; and a working knowledge of the properties of metals. Other requirements may include a knowledge of geometry and trigonometry, and of machine design, welding techniques and heat treatments. With the introduction of the many new control processes which have been mentioned, a knowledge of hydraulics, pneumatics and electronics is an asset.

With the advent of new machines and processes, the importance of all-round machinists in the functions of repair and maintenance has considerably increased. To keep machine stoppages to the minimum and thus reduce production costs, the maintenance machinist is required to exercise considerable ingenuity to effect speedy repairs. When a production machine fails, the machinist (usually accompanied by a maintenance electrician) is called to the job. Their first task is to locate and isolate the trouble and to make either temporary or permanent repairs. Next, they instruct the production department on how to prevent a recurrence of the stoppage. Finally, the machinist will either repair the defect or make and install new replacement parts.

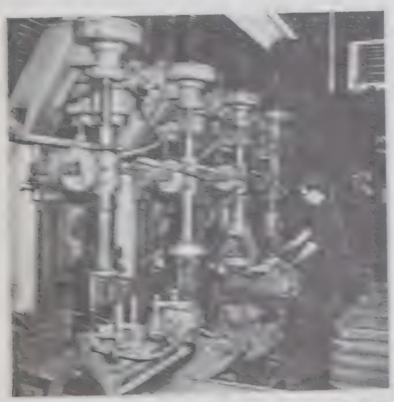
In making a new part, the machinist will decide the series of operations required and will carry them out in their entirety. This is also true of the machinists in smaller shops who undertake custom and jobbing work (making one or a few items).

In shops where large quantities of similar items are to be made, such as automotive plants and equipment maunfacturers, the series of operations is usually divided among all-round machinists, machine operators, machine tenders and the specialists about to be described.

The machinist explains setting operations to the apprentice.
Photo: N.F.B. 1277



Horizontal milling on a Universal milling machine.
Photo: General Motors



Castings being drilled on a multiple-spindle drill.
Photo: International Harvester

Cutting a screw thread on an engine lathe.
Photo: General Motors

Surface grinding.
Photo: International Harvester

Guided by a master template (right) this milling machine requires little setting.
Photo: N.F.B. 56014

MACHINING—PRODUCTION WORK

In long production runs, the all-round machinist is primarily engaged in the repair work already described, and in supervision, machine setting, making trial runs and in generally ensuring that production proceeds satisfactorily. Production machines are equipped with semi-automatic or fully-automatic controls and tools such as jigs, fixtures and templates are used, all of which are designed to reduce skill requirements to a minimum. These machines are controlled by machine operators and machine tenders who, in contrast with the all-round machinist, are usually trained in one phase of the work or on one type of machine only.

When considering a career in metal working it is important to recognize this difference in training: all-round craftsmen because of their wide training can move more freely from one job to another and are less likely to be affected when one job disappears because of technical changes; this may be less true of the worker trained in one specialty only.

Planning

The first step in the production of any item is to decide the most economical sequence of operations noting, from engineering drawings, heat treatments and other techniques and the degree of accuracy desired. Planning is undertaken by *process planners*—engineers or technicians recruited from draftsmen, all-round machinists or other highly skilled workers. Special tools such as jigs and fixtures are also considered in conjunction with *tool designers* and are made by tool makers.

Marking Out

Marking out—the scribing of lines to be machined—is the next step, although this step is not necessary in long production runs because jigs and fixtures are used. In general, metal to be drilled, bored, milled or planed requires more marking out than that which has to be turned.

Marking out may be done by *lay-out men* or *layers-out* working from drawings and other instructions, to mark guide lines on castings, forgings and other metal stock. These lines provide guides in setting up the work and in the actual machining. Equipment used

as aids to marking include height gauges, sine bars, T-squares, protractors, centre punches and calipers.

Setting

The operator may select cutting tools, set gears to determine correct speeds and feeds, and adjust cams and stops to limit movement of the tools or workpiece, and, after mounting the marked-out metal stock, proceeds with the actual machine operations.

Alternatively, setting may be done by *setters* or *set-up men*, who are responsible for several machines. After the machine has been set, they make trial runs to ensure that the part is being machined correctly, then turn the machine over to a *machine tender*.

Machine Operation

Machine shops are usually equipped with a variety of metal-working machines on which machining operations such as turning, drilling and boring, shaping and planing (milling), and grinding can be undertaken.

Turning is done on lathes—probably the most versatile machine tool in the shop—and is a method of producing external and internal cylindrical shapes. Lathes vary in size and capacity from small bench machines used by watchmakers to those capable of turning components many feet in diameter such as turbines, or rollers for papermaking machines.

The standard lathe (or "engine lathe") consists basically of a horizontal bed carrying a mounting at each end known as a "head-stock" and a "tailstock" respectively. Between them, and sliding on an adjustable carriage, is a post to hold cutting tools against which the metal is turned. This type of lathe will be found in job and custom shops making a variety of different items and will be set, adjusted and operated either by an all-round machinist or in a production shop by a *lathe operator*.

In production shops making large quantities of similar items, lathes such as turrets, capstans and automatics are more likely to be used.

Capstans and turrets are similar to the standard lathe except that the tailstock is replaced by a mounting (a turret) holding a variety of tools which can be used in sequence. In automatics, the principle is carried one step further; the headstock holds a number of tools and several workpieces can be machined at the same time.

Speed (the rate of revolution of the workpiece) and feed (the rate at which the cutting tool travels), the depth of cut at each traverse and sequence of operations all have to be set. This is often the work of a *machine setter* although it may be done by a lathe operator. After the machine has been set it may be turned over to a *machine tender*. A tender is merely required to gauge the accuracy of the work at intervals, insert new workpieces, regulate the flow of coolants, remove swarf (waste) and report malfunctions.

Drilling and *boring* are methods used to cut, enlarge or finish round holes with a rotating cutting tool. These operations may be done on either power or hand operated drills ranging from single drills and radial-arm drills to numerically controlled machines used to drill large numbers of holes in rapid sequence or simultaneously.

Instructions as to the position and size of holes to be drilled are shown on the engineering drawing, and may be indicated on the metal stock by a punched mark. In single drilling, the *driller* selects the correct size drill, secures it in the drill chuck, and lowers the rotating drill onto the workpiece. On repetition work, drill jigs with bushed locating-holes made by a toolmaker are used instead of marking out. With the drill speed suitably adjusted, holes can also be reamed, tapped, counter-sunk, lapped and ground.

Where extreme accuracy is demanded, holes may be cut with a boring machine. This machine has a cutting tool secured to the end of a rotating boring bar and is set and controlled by a *borer*.

When a machinist has to remove metal to produce flat, angled or curved surfaces, or to produce slots or special profiles such as gear teeth, he may use a variety of machines such as shapers, planers and milling machines. Other variants of this work are done on less commonly used machines such as broachers and slotters.

Grinding is the process of shaping metal by bringing it into contact with rotating abrasive wheels. Mainly used on hard metals, it provides a degree of accuracy and finish not possible by other methods of machining. By using a variety of grinding methods, the machinist can produce plain or curved surfaces, or special shapes such as screw threads or gear teeth, or do finishing operations such as honing, buffing and polishing.

As in other machine operations, a variety of skills is involved, and some grinding jobs may be done by specialists such as *universal grinders, tool grinders* and *thread grinders.*

HEAT TREATMENT

At various stages of machining, it is sometimes necessary to change the properties of the metal by heat treatment. Electric or fuel-burning furnaces are used to heat the parts, and tanks containing water, oil or salts such as brine are used for cooling. Typical heat treatments include tempering, hardening, annealing and normalizing, each method used according to the change desired in the metal.

This may be the work of the machinist or toolmaker although in production shops, heat treatments are usually carried out by specialists known as *annealers, hardeners, temperers,* and *case hardeners.*

FITTING AND ASSEMBLY

Articles usually consist of two or more parts which must be fitted, assembled and fastened together. In production shops turning out large quantitiees of similar articles, the parts will be standardized and interchangeable, and assembly done by *assemblers.* In more complex products, or where high degrees of accuracy are required, assembly-line methods may not suffice, and this stage of production may be carried out by a *fitter* or *bench machinist.* The work requires skill with hand tools such as files and scrapers to remove small amounts of metal, as well as the use of grinding wheels, lapping machines, reamers, micrometers and gauges to achieve the accuracy characteristic of the machinist's trade.

INSPECTION

Inspection is a very broad term used to cover many duties, all of which are to ensure that the finished product meets the design specification and will thus fulfil the purpose for which it is intended. Duties of the inspection staff are two-fold: to reject inaccurate parts and, more importantly, to investigate and rectify defects.

There are several stages of inspection. Materials and parts bought from other companies usually receive a visual inspection although items may be selected from each batch for more rigorous testing, i.e., dimensional checks and hardness tests to ensure the specification has been met. This is the work of the stores staff or inspectors.

Testers are often stationed to check components at various stages of manufacture although craftsmen such as machinists may test and be responsible for the output of their machines.

Situated in view rooms are *gaugers, examiners* or *viewers* who, using fixed gauges of standard types, examine simpler components such as brackets, rivets and bolts.

Adjustable measuring devices are used by *inspectors* and range from the micrometer and vernier which can be used after a short period of instruction, to highly complex measuring instruments requiring a considerable knowledge of mathematics. These include optical comparators to detect very small errors; profile projectors which provide an enlarged shadow of the component on a screen; and glass or quartz optical flats, ground to an accuracy of two millionths of an inch, which indicate irregularities through a series of colour bands. There are many similar devices, often for a special purpose or adapted to meet the requirements of a particular test.

Equipment used in inspection work is returned periodically to a Standards Room, equipped with extremely accurate reference instruments and kept at a constant temperature and humidity to maintain accuracy. In the Standards Room, highly skilled inspectors and machinists ensure that all instruments, gauges and other test equipment used on the production floor are accurate.

The tool-and-die maker operates machine tools to very high standards of accuracy.

Photo: N.F.B. 84008

TOOL AND DIE MAKING

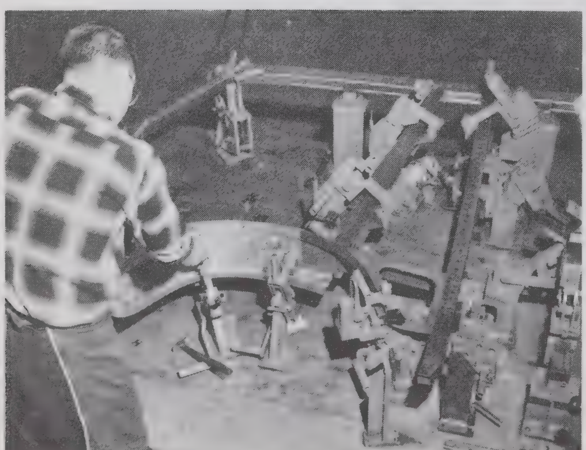
It is the usual practice for tools such as drills, reamers and cutters to be made by specialist companies. Special tools such as dies, templates, drilling jigs and holding fixtures are also required and these are often made by tool and die makers employed by the metal manufacturing company.

The *tool maker* constructs special cutting tools used to shape metal stock. He also makes jigs and fixtures used to hold metal stock and tools in place during machining, and makes gauges and other measuring instruments used to check the accuracy of parts. Maintenance or repair of tools, jigs and fixtures is another of the tool maker's responsibilities.

The *die maker* is primarily concerned with the shaping of dies with which machines are fitted to cut, stamp or shape the materials used in production—sheet metal, plastic, cloth, leather. They also make the closed dies used in machine forging processes.

Toolmakers use precision measuring instruments such as this height gauge.
Photo: N.F.B. 3732

Skills with the hands are required when making press tools.
Photo: N.F.B. 3732



This fixture, made by a toolmaker, is used to hold components while they are welded.
Photo: General Motors

Tool and die making is similar to the work done by machinists, in that all standard machine tools and machining processes are used. The difference lies mainly in the need to work to closer tolerances, with harder, more durable metals, and the need to understand the purpose and function of the tools and dies being made. The tool maker may, for instance, be required to help with the design of new types of tools, and may eventually become a *tool designer*. Tool and die making has become an exceedingly important and complex craft in modern industry, with many specialized fields such as cam making, gauge making, die setting, diamond mounting, etc.

INSTRUMENT MAKING

Instruments used to measure and control heat, volume, pressure, weight and other physical properties in scientific research and to help control industrial processes are constructed by craftsmen known as *instrument makers*.

They are employed chiefly in laboratories (where they may be known as model makers and experimental machinists) although others are employed by companies which manufacture survey equipment (theodolites), aircraft equipment (altimeters), industrial equipment (controllers), optical products (inspection comparators) or in defence installations.

In general, instrument makers use skills and tools—lathes, grinders, drills, shapers, hand files and scrapers—similar to those of machinists although a much higher standard of accuracy is demanded. Where instruments are standardized, their production is divided into stages such as is used in the manufacture of other metal products and undertaken by machinists, assemblers and inspection staff. Unlike machinists, however, making similar items from engineering drawings and specifications, instrument makers usually produce non-standard items often for a single purpose from sketches and oral instructions. In addition, instrument makers use and are required to know the properties of plastics, glass, wood and the less-common metals: gold, platinum, silver, etc.

To develop this original equipment, an understanding of the use of instruments and their principle of operation is required together with high reasoning power and a better than average ability to work with the hands.

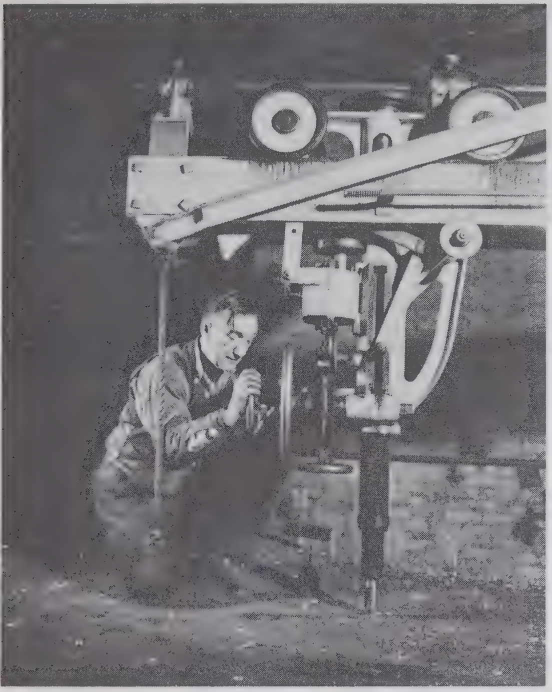
BOILERMAKING

Boilermaking is concerned with the shaping and assembly of heavy iron and steel plate into tanks, vats, boilers and similar containers to hold liquids and gases usually stored under pressure. This is the work of boilermakers and the production workers indicated in the following paragraphs.

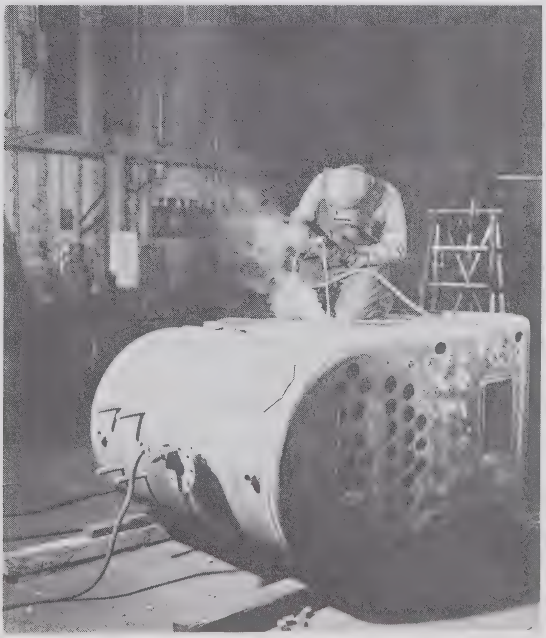
Marking out, the first step in boilermaking, is the work of boilermakers who specialize in this phase of manufacture and are often called *lay-out* men or *markers-out*. From engineering drawings, they indicate on the plate where it is to be cut, drilled, bent and otherwise formed. In addition to the ability to read and interpret these drawings and sufficient knowledge of mathematics to develop full-scale plans from the scales and data given, the markers-out require skills in the use of scribes, gauges, rules, scales, dividers and other tools.

Next the plate is cut to shape by *oxyacetylene cutters, power-shear operators* and *power-saw operators* and is further worked by *operators* of punching machines, rolling and bending machines, planers and similar machine tools. The plate may be heated and, in this case, techniques similar to forging are used to shape the plate.

The parts are fabricated into units by *assemblers, rivetters* using pneumatic hammers, and by welders. These fabricated units are then assembled in the shop by boilermakers known as *fit-up men* who also install nozzles, valves, tubes and other parts and then correct any irregularities. Assembly is undertaken using wrenches,



The boilermaker drills steel plate which will be fabricated into a boiler.
Photo: N.F.B. 29965



Parts are welded to the base of the boiler by this government-approved welder.
Photo: N.F.B. 29969

hammers, files and other hand tools, and machines such as portable drills, grinders, and welding machines. At the same time, supporting structures are also prepared by structural steel workers, rivetters and their helpers.

If the completed container is too large for transport it is then dismantled; alternatively, the container is completed by the welders and rivetters.

When pre-fabricated units are delivered at the construction site the *boilermaker* assembles them and, in conjunction with structural steel workers, secures the container in position. Finally, the boilermaker examines the completed assembly for defects and ensures that the container operates satisfactorily.

In addition to those employed in construction and assembly work, many boilermakers are employed in maintenance and repair in public utility, transport and industrial organizations such as shipbuilding yards, railroads, chemical plants and petroleum refineries.

Skills in the use of hammers, wrenches, oxyacetylene torches, rivetting equipment, caulking equipment, and the hoists, jacks and cranes used in erection are required of boilermakers. In addition they need to be able to decide the best way a job should be done and have the ability to improvise. Some of the work is not light and requires at least average strength; erection and maintenance work may be at heights or in cramped and hot surroundings.

SHEET-METAL WORK

Many different establishments are engaged in sheet-metal work. They range from small, owner-operated shops repairing domestic equipment, to those which are departments of large companies manufacturing automobiles or aircraft. Other sources of employment include companies who manufacture boats, locomotives, metal furniture and domestic appliances.

A sizeable proportion of sheet-metal workers are employed in the construction industry, making and installing ducts for air-conditioning and similar equipment in commercial and residential buildings. These workers are described in CAREERS IN CONSTRUCTION in this series.

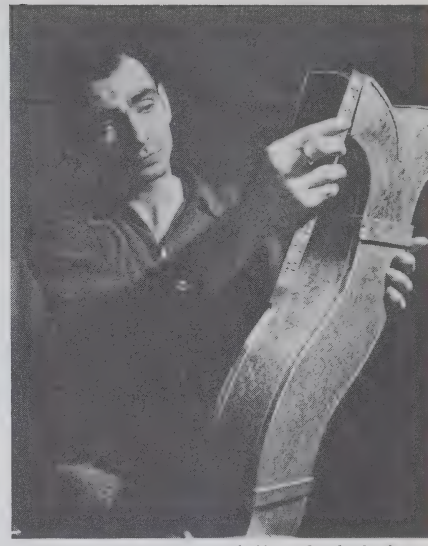
As the name indicates, articles are made from flat sheets of steel, zinc, light alloys and other metals by the *sheet-metal worker*; similar work in copper or brass is done by a *coppersmith*. In general, all-round sheet-metal workers, from drawings and specifications, undertake the following: mark and lay out work; cut to size with hand shears or power tools such as nibblers and guillotines; shape with hammers, mallets or power-operated equipment; punch, drill and trepan holes for rivets, bolts and other components; and join sections by soldering, welding, brazing, rivetting, seaming and hinging.

Presses are used for production runs of similar items from sheet metal. These vary from small, hand-operated fly presses to complicated machines with multiple tools such as are used to produce automobile bodies.

The principle of operation is similar in that all presses use a punch of hardened steel to drive the sheet metal into a die which is so shaped that the article is formed and cut.

In the case of heavy, power-operated presses using complicated tools, a *setter-operator* may be in continuous control of the machine but the majority of presses are set by *press setters* and then handed over to *power-press operators* or *tenders*.

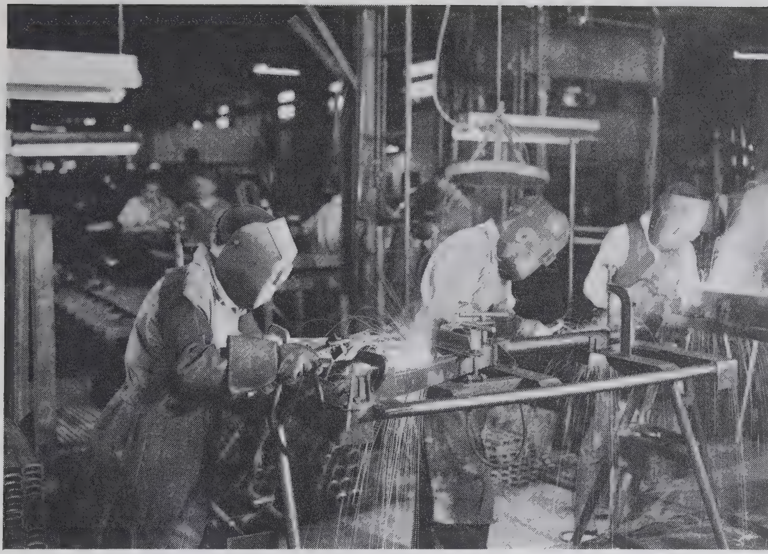
The apprentice sheet-metal worker is instructed in the use of hand tools.
Photo: N.F.B.



Parts must be carefully checked for accuracy.
Photo: N.F.B.

The sheet-metal worker must know how to weld.
Photo: N.F.B.

Machines such as this 36-ton press brake are used in production shops.
Photo: N.F.B.



A production welding shop in the automotive industry.
Photo: N.F.B. 23398

WELDING

Many of the metal parts used in bridges, pipelines and other structures, in automobiles, ships and the framework of certain aircraft, in air-conditioning systems, refrigerators and in hundreds of other articles are joined by a process known as welding.

Skill requirements demanded of welders vary considerably according to the process in which they are engaged and the type of metal being joined. The operation of welding machines can be learned in a few weeks: in contrast, all-round welders require several years of apprenticeship. Certain welders such as those engaged in the welding of aircraft parts and those who weld boilers and other pressure vessels are required to pass government tests at periodic intervals.

Today there are over forty different welding processes, most of which have been developed because of the many different metals and alloys which have made their appearance over the past decade. Of these many methods, the three most commonly used—fire welding, fusion welding and resistance welding—have been selected to give general outlines of the kinds of work involved.

Fire welding is the traditional method used in the forge shop. In this method, the ends of the metal to be joined are heated and hammered together either by hand or power-operated hammers.

Fusion welding consists of heating the metal parts, either with a gas flame or an electric arc, until their melting point is reached and introducing a third piece of metal in the form of a welding rod into the joint so that a permanent union is made.

Manual oxyacetylene welding is the favourite method of the small operator because of its adaptability and is also the preferred method for cast iron. In addition to manual operations, semi- and fully-automatic control systems may be used, particularly in machine processes. In manual operation, the *oxyacetylene welder* (or gas welder) applies an intensely hot flame through a welding torch to the edges of the metal until they begin to melt. Filler metal is then added from a welding rod to the joint. The welder's duties include the selection of correct torch tips and welding rods and also the size and type of flame according to the metal and kind of joint required.

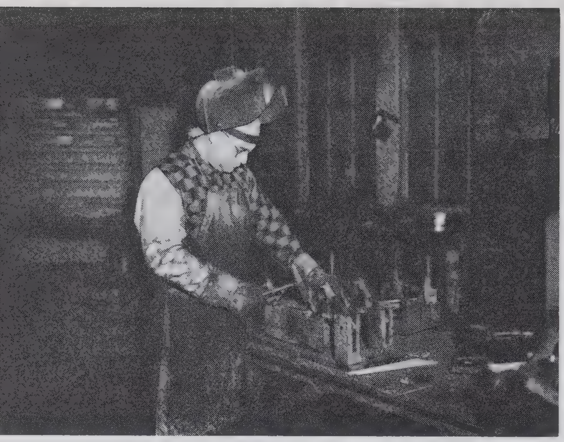
Electric arc or metallic arc welding is the commonest method in use, particularly in machine processes producing similar items, since electrical power can be quickly and easily controlled. In manual operations the duties of the *arc welder* are similar to those of the gas welder in that the edges of the metal are heated and filler metal added. However, where the gas welder heats the metal from a torch, the arc welder "strikes" an arc (passes an electric current) by touching the metal part to be welded with an electrode which also provides the metal filler. By withdrawing the electrode a short distance from the metal, an arc is formed which creates sufficient heat to melt the metal. The arc welder sets and adjusts amperage controls on the electrical power source to obtain the correct temperatures and selects welding electrodes for the job in hand. Recent years have seen the development of improved arc welding techniques where the weld area is shielded with an inert gas such as argon or carbon dioxide. Many welders are now specializing in this technique to weld the difficult metals, stainless steel, aluminum and magnesium.

Resistance welding is a machine process where metal parts are fused by bringing them together under heat (obtained from an electrical source) and pressure. This is the work of *welding-machine operators* who may specialize in one of several forms of machine welding and may be known as spot welders, butt welders, flash welders or bar welders. Resistance welding may also be done with portable welding guns. Machine operators regulate heat and pressure controls, feed and align workpieces and remove the unit when work is complete. Cold-pressure welding is also a machine process where pressure—but not heat—is applied through flat or tapered rollers to join aluminum foil, lap joints in copper and electrical connectors; simplicity of operation is the main feature of this method.

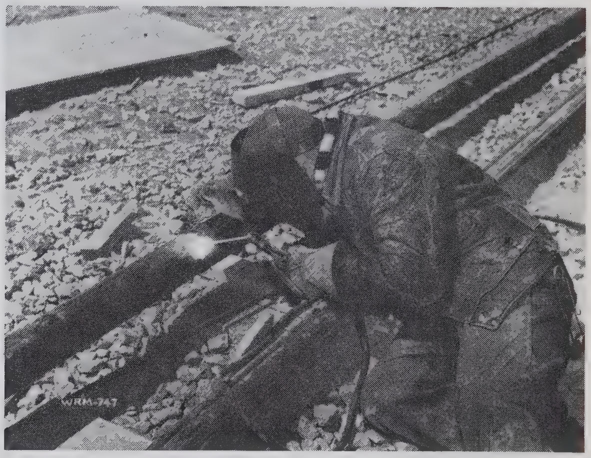
Other welding processes which are changing the skill and knowledge requirements of welders include those using friction, explosives or a focussed beam of electrons as a source of heat.

Closely related to welding is "flame cutting" in which *flame cutters* or oxygen cutters direct a flame of fuel gas and oxygen onto metal parts to trim and cut them to the desired shape. The flame cutter selects torch tips and working pressures and, in addition, may be required to mark guide lines on the workpiece from drawings or oral instructions. Alternatively, the cutting torch may be machine mounted and guidance supplied by mechanical or electronic means. In the latest developments, an electronic guidance system can trace and cut complex shapes directly from a drawing.

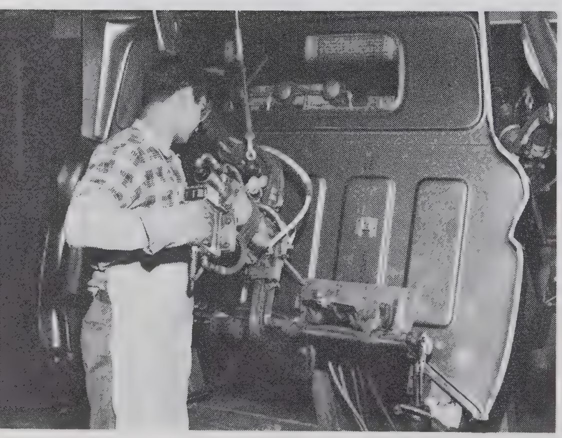
As with welding, many developments are taking place, all of which may change the skill requirements of the worker. Briefly, these include the "plasma arc", a constricted electric arc, which provides exceedingly high temperatures to greatly increase cutting (and welding) speeds; the "Laser" process, a beam of light amplified many times, which will pierce a diamond in a 200 millionth of a second; and oxygen lances used to cut and gouge great thicknesses of steel.



The bench welder chips excess metal from the weld.
Photo: International Harvester



Pipeline welders must be government-approved.
Photo: N.F.B.



A production welder uses a portable spot welding gun.
Photo: General Motors

WORKING CONDITIONS

Working conditions will depend on the branch of the industry in which the worker is engaged and, to some extent, on the age of the plant. In general, most metal-working occupations involve contact with dirty materials and often are of a strenuous nature.

Workers near blast and steel furnaces are exposed to considerable heat; the atmosphere in rolling mills is hot and noisy; and in some forging and foundry processes, dirt and heat are to be encountered.

Heavy muscular labour which was once typical of the metal working industry has been considerably reduced by the introduction of mechanical aids such as hoists, cranes and conveyor systems. However, except where fully mechanized processes have been adopted, physical effort may still be required; in all processes there is much bending and stooping and most of the work is done standing. For these several reasons, young people entering the industry require good health, a reasonably good physique, muscular co-ordination and the ability to stand for long periods.

Many workers are in production teams and must be able to understand instructions and be willing to carry them out quickly. They are required to co-operate with fellow-workers and have a keen sense of responsibility not only in regard to their own safety but also that of others with whom they may be working.

In the operation of machines, there is a certain amount of noise and the presence of oil, cutting fluids and metallic waste to contend with. Those working near and around machines must be alert to avoid hazards such as cuts and burns which are associated with high speed cutting tools and machines; again, a keen sense of responsibility is demanded.

Machining occupations are not arduous although in erection and heavy press departments, workers require a good physique and manual dexterity. Much of the work demands an extremely high standard of accuracy and therefore requires workers who are painstaking and pay great attention to detail; the ability to concen-

trate on repetitive tasks is required of a number of operators. Machine shops are usually large well-ventilated buildings whose tempertaures are seldom abnormal.

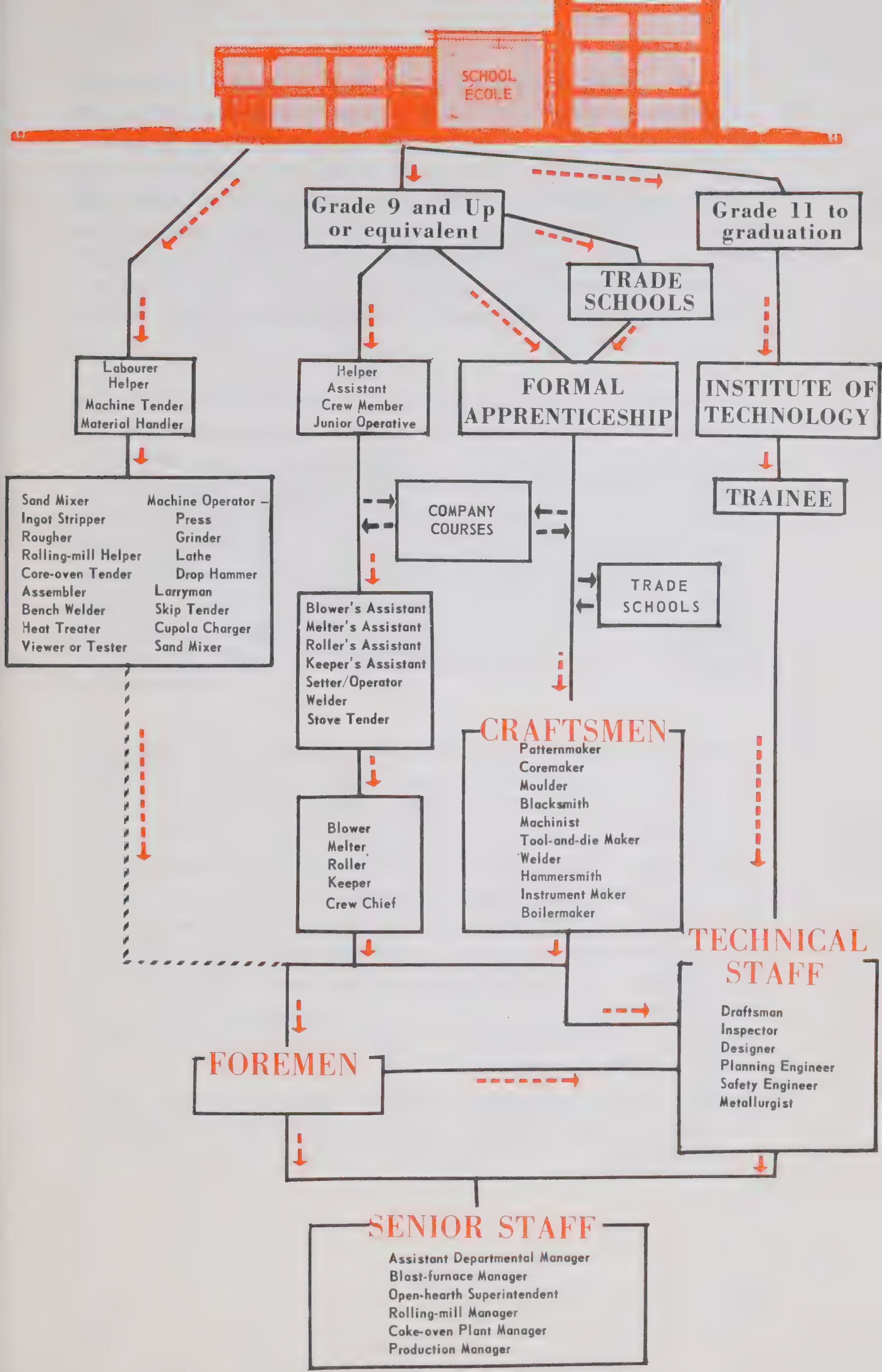
Welding, like most manual occupations, demands a good standard of physical fitness. Depending on the type of industry, the work may be indoors in a fabricating plant or outdoors such as on pipeline installations or building sites. Good hearing and eyesight are necessary as is manual dexterity. Working in close co-operation with other trades such as building workers, inspection staff and fabrication workers requires the ability to get along with others.

ENTRY AND ADVANCEMENT

Entry and advancement are usually by one of the routes shown on page 61. It must be pointed out however that, for ease of understanding, only general routes have been illustrated. Since metalworking skills are learned on the job through practical working experience, many ways of advancing are possible subject only to the ability and determination of the worker. For example, a labourer could obtain sufficient skills on the job to advance to machine tender and then to specialist machinist; further advancement to a department such as the planning office could be obtained by taking courses of part-time study.

Depicted in the first group are entry occupations in material handling, routine processes and labouring. Advancement from this group is open to energetic workers who, through their own efforts, "pick up" additional skills and obtain related knowledge through part-time courses.

In the second group, entry occupations as crew members, helpers and others in industrial processes are shown. They usually enter a company after high-school courses and are taught the processes of industry by practical training given in a series of progressive steps and in company-sponsored courses. This training together with such factors as job performance, capacity for higher level work and seniority can lead to advancement to crew leader or foreman as openings arise.



SCHOOL
ÉCOLE
Grade 9 and Up or equivalent
Grade 11 to graduation
TRADE SCHOOLS
Labourer
Helper
Machine Tender
Material Handler
Helper
Assistant
Crew Member
Junior Operative
FORMAL APPRENTICESHIP
INSTITUTE OF TECHNOLOGY
TRAINEE
Sand Mixer
Ingot Stripper
Rougher
Rolling-mill Helper
Core-oven Tender
Assembler
Bench Welder
Heat Treater
Viewer or Tester
Machine Operator –
Press
Grinder
Lathe
Drop Hammer
Larryman
Skip Tender
Cupola Charger
Sand Mixer
COMPANY COURSES
TRADE SCHOOLS
Blower's Assistant
Melter's Assistant
Roller's Assistant
Keeper's Assistant
Setter/Operator
Welder
Stove Tender
CRAFTSMEN
Patternmaker
Coremaker
Moulder
Blacksmith
Machinist
Tool-and-die Maker
Welder
Hammersmith
Instrument Maker
Boilermaker
Blower
Melter
Roller
Keeper
Crew Chief
TECHNICAL STAFF
Draftsman
Inspector
Designer
Planning Engineer
Safety Engineer
Metallurgist
FOREMEN
SENIOR STAFF
Assistant Departmental Manager
Blast-furnace Manager
Open-hearth Superintendent
Rolling-mill Manager
Coke-oven Plant Manager
Production Manager

Others, shown in the third group, make a decision to enter the industry as an apprentice. This is an entry occupation most sought after since it leads to recognition as a skilled craftsman. First, however, it is necessary to find an employer who is willing to enter into an apprenticeship agreement; the chances of obtaining this entry occupation are greatly enhanced by taking pre-employment courses in trade or technical schools as described in the paragraphs dealing with preparation and training. Again, job performance, capacity for higher level work and seniority lead to advancement to supervisory positions.

An alternative route, particularly for those with the ability to advance to senior positions, is by first taking a course of study—usually two to three years after high school—in an institute of technology. The entry occupation may be that of trainee and, depending on the company, the trainee receives practical training in various phases of the company's activities before being assigned to the drawing office, production floor, laboratory or other technical department; alternatively, the trainee may go directly to a technical department as, for example, a junior draftsman or production planner. Further advancement is possible to senior positions on demonstrated ability.

With the foregoing in mind it will be evident that entry and advancement depend on two main factors: the level of education on entry and the steps taken while in employment for self-improvement. There is a third equally important factor to be taken into consideration. The new materials, processes and techniques—these are known as "technological changes"—which were mentioned briefly when kinds of work were described are making some metalworking jobs more complex and eliminating others, particularly those requiring manual skills only. Employers therefore look for new entrants who have sufficient education on entry to learn complex processes and to adapt to the changes which will occur in the future. In addition, because of these changes, workers can expect to study, probably throughout their working lifetime, if they are to maintain their competency or advance to higher positions.

PREPARATION AND TRAINING

Preparation for entry into the metal working industry can be obtained by young people still in school through high school "shop" courses designed to teach manual and technical skills. Depending on the school and the courses selected, training may range from shop practices, servicing and factory assembly work to tuition in shop mathematics, metallurgy, drafting and industrial techniques. Shop courses have the added advantage of helping to decide one's interest and ability in metal working.

VOCATIONAL EDUCATION

For those who have left school, courses are available in trade schools which are related to specific occupations such as welder, sheet-metal worker or machinist. Both day and evening courses are provided and they vary in length according to the subjects taken, ten months being the average. The time in trade schools may be allowed against the period of apprenticeship. Again, attendance at trade schools will help demonstrate one's interest and ability in metal working.

TRAINING ON THE JOB

Training for the occupations described in this booklet must be taken on the job and varies according to the occupation. Some jobs such as material handling are relatively simple and the beginner is expected to pick up the necessary skills after a short introductory talk by a supervisor. Other beginners are selected for training in certain processes by a particular company. This training may consist of periods in various sections of a department supplemented either by company instructors or in company-sponsored courses at local technical schools.

Apprenticeship is another method of training and this consists of a long-term period of systematic instruction usually extending over four years. During the training period, the apprentice under

the direction of skilled workers learns the practical aspects of the trade. The theory of the trade may be taught in the company or, as is more usual, the apprentice may attend a municipal or provincial technical school for several weeks each year. The trade school provides tuition in mathematics, mechanics, drafting or similar subjects also an opportunity to practice techniques which are difficult to learn on the job.

Trade tests may be given from time to time, records of progress kept and a certificate of proficiency issued at the end of the apprenticeship. During the training period, some apprentices are expected to acquire their own tool kit which may cost up to $500.

The training program may be in the form of a contract known as an "indenture" between the employer and the apprentice which states length of apprenticeship, skills to be taught, pay scales and similar details. Other apprenticeships may be less formal. Some crafts are "designated" by provincial governments; that is, entry must be in accordance with the regulations shown on page 67. Pay scales, skills to be learned and other requirements are also defined. These schemes are administered by the Apprenticeship Branch of the provincial Department of Labour or, in the province of Quebec, by Apprenticeship Commissions.

The following Table shows the metal-working apprentices registered with various provincial Departments of Labour.*

	Nfld.	N.S.	N.B.	Ont.	Man.	Sask.	Alta.	B.C.	Total
Blacksmiths	—	—	—	1	1	—	—	—	2
Boilershop workers	—	6	—	2	—	—	—	17	25
Instrument makers	2	—	15	31	—	—	—	15	63
Iron workers	—	—	—	1	—	—	—	20	21
Machinists	9	57	31	247	46	—	61	158	609
Moulders	—	3	—	5	—	—	—	16	24
Patternmakers	—	4	1	6	—	—	—	7	18
Sheet-metal workers	2	73	46	488	117	63	287	123	1,199
Steel fabrication workers	—	7	—	—	—	—	—	40	47
Welders	5	2	55	14	—	42	547	26	691

*Source: Technical and Vocational Training Branch, Department of Labour, Ottawa, June 30, 1963. Table does not necessarily indicate the total number of apprentices in trades listed.

There are no set age limits for entry into the metal working industry but apprenticeships are usually reserved for young people below 20 years of age.

In the primary *iron and steel industry*, new entrants nearly always start as unskilled help, either as labourers or learners. Training is given on the job where the entrant starts with the simplest of tasks and progresses as experience and "know-how" are acquired. Steel making companies are very active in planned courses of instruction often in co-operation with local trade and technical schools and, for this reason, prefer grade 10 and upwards of their new employees.

In *foundries*, two occupations—patternmaking and moulding—are apprenticeable trades. Patternmakers may also be selected from those who have completed an apprenticeship as a machinist. Where there is division of labour, machines for moulding, cleaning and finishing castings, mixing sand and transporting materials are tended by machine operators. After a short period of instruction the learner is expected to become an efficient operator in about one month.

In *forge shops*, the occupations of blacksmith and hammersmith are apprenticeable during which time the apprentice learns the care and operation of the forge, heat treatment of metals, use of tools, forging techniques and how to estimate and select metal stock. Operation of hammers and other powered equipment is learned on the job, the length of time depending on the ability of the worker, the equipment being used and the process involved.

In *machining and related processes,* all-round machinists are trained through apprenticeship. During this period, apprentices learn how to read engineering drawings and specifications, the use of measuring instruments such as micrometers, verniers, calipers and protractors and to develop skills with hand tools. They are instructed on machine tools to learn the variety of uses to which they can be put as well as their limitations. In time, they are taught how to plan jobs and carry them through to their conclusion.

PROVINCIAL REQUIREMENTS	BLACKSMITH	DIEMAKER	HAMMERSMITH	MACHINIST	MOULDER	PATTERNMAKER	SHEET-METAL WORKER	TOOLMAKER	WELDER
	TRADES AND CRAFTS DESIGNATED BY PROVINCES								
BRITISH COLUMBIA									
Apprenticeship—years	4	5	—	5	4	5	5	5	3
*School Program	‡	‡	—	4-4-4-4	‡	‡	4-4-4-4	‡	‡
Minimum Education—grade	†	†	—	†	†	†	†	†	†
ALBERTA									
Apprenticeship—years				4			4		3
*School Program				8-8-8-8			10-8-5-8		6-6-4
Minimum Education—grade				10			9		9
SASKATCHEWAN									
Apprenticeship—years				4			4		4
*School Program				8- - -			7-7-7		6-6-6 or 10
Minimum Education—grade				10			10		8
MANITOBA									
Apprenticeship—years	4			5			5		
*School Program	8-6-4			10-8-6-4			6-6-6-4		
Minimum Education—grade	9			9			9		
ONTARIO									
Apprenticeship—years	4	4	4	4	4	4	4	4	4
*School Program									
Minimum Education—grade	8	10	8	10	10	8	8	10	8

QUEBEC									
Apprenticeship—years							4		4
*School Program							35-4-4-4		35-4-4-4
Minimum Education—grade							7		7
NEW BRUNSWICK									
Apprenticeship—years	4			4		5	4		
*School Program	8-8-8-8			32 total		‡	‡		
Minimum Education—grade	9			8		9	8		
NOVA SCOTIA									
Apprenticeship—years							4		
*School Program									
Minimum Education—grade									
PRINCE EDWARD ISLAND									
Apprenticeship—years									
*School Program									
Minimum Education—grade									
NEWFOUNDLAND									
Apprenticeship—years									
*School Program									
Minimum Education—grade									

* Weeks of full-time attendance in each year of apprenticeship. † Minimum education not specified. ‡ Evening classes only.

Table 1—Trades and Crafts Designated by Provinces.

Training for machine operators is given on the job and varies with the type of machine and the degree of skill and responsibility required of the worker. The skilled operator who is able to set and operate a machine unassisted may take one or two years to learn.

Tool and die makers, in most cases, are trained through apprenticeship: in others, it may be an extension of the training for machinists. For this work, classroom tuition is essential in shop mathematics, machine and tool design, metallurgy and production planning.

Sheet-metal workers are also trained through apprenticeship where they are taught the following: how to lay out and mark work using rulers, scribers, calipers and gauges; how to handle tools such as mallets, hammers, shears, files and saws; how to operate fabricating machines such as the bending brake, seaming machine, angle shear, rotary shear, slitting shear and power hacksaw; and methods of joining metals such as bolting, seaming, rivetting, soldering, brazing and welding. In addition, depending on the field of work, they may receive training in such specialties as air-conditioning, architectural or building construction work.

Welding may be learned through apprenticeship or through several other means. Day and evening courses are provided in many municipally operated technical and vocational schools and in some provincial technical institutes. Short courses of 6 to 20 weeks and designed to prepare for the position of welding operator or in one specific type of welding are offered. Longer courses, up to 40 weeks, and leading to more advanced positions may also be available. Home study courses to teach the theory of operation and methods can be obtained from a number of sources such as the Canadian Welding Bureau, 1393 Yonge Street, Toronto, Ontario; they can also supply information on scholarships which are offered from time to time.

ORGANIZATIONS

In most of the large metal-working companies such as automotive or steel making, the workers will be members of an industrial union under contract with the management. Unions are also active throughout the industry on a craft or local basis. Selected as typical from the 1962 edition of LABOUR ORGANIZATIONS IN CANADA (published annually by the federal Department of Labour) are the following:

UNITED STEEL WORKERS OF AMERICA—AFL-CIO/CLC

INTERNATIONAL UNION, UNITED AUTOMOBILE, AEROSPACE AND AGRICULTURAL WORKERS OF AMERICA—AFL-CIO/CLC

SHEET METAL WORKERS INTERNATIONAL ASSOCIATION—AFL-CIO/CLC

INTERNATIONAL ASSOCIATION OF MACHINISTS—AFL-CIO/CLC

INTERNATIONAL ASSOCIATION OF BRIDGE, STRUCTURAL AND ORNAMENTAL IRONWORKERS—AFL-CIO/CLC

INTERNATIONAL MOLDERS' AND ALLIED WORKERS UNION—AFL-CIO/CLC

INTERNATIONAL BROTHERHOOD OF BOILERMAKERS, IRON SHIP BUILDERS, BLACKSMITHS, FORGERS AND HELPERS—AFL-CIO/CLC

PATTERN MAKERS LEAGUE OF NORTH AMERICA—AFL-CIO/CLC

The employment outlook for the metals industry as a whole is favourable and an over-all moderate rise in the labour force is expected during the 1960's. In addition to the need to replace workers, the growth made in the industry over the past decade is expected to continue and thus create further job opportunities.

Any marked increase in the size of the labour force however will be governed to a large extent by the rate of introduction of new materials or new techniques such as mechanized processes and automatic controls (automation). Although it is too early to measure the effects of automation, evidence indicates that metal-working companies are increasing their output without a corresponding increase in the number of workers on their payroll. Introduction of new techniques will not affect all workers equally: in general, employment of skilled workers tends to rise while that of semi-skilled and unskilled workers declines.

In iron and steel making, a continued rise in production is indicated. This branch of the industry (in common with several others) is sensitive to general economic conditions: during periods of prosperity, items which use large quantities of steel such as buildings, automobiles and machinery products are in demand; conversely, during recessions the sale of these items falls. Many technical problems have yet to be overcome which are slowing up the introduction of automation and consequent replacement of labour by machines. It is therefore predicted that opportunities in iron and steel making will continue to grow at a moderate rate, characterized by fluctuations from time to time according to general economic conditions.

In foundry work, there is an indication of an increase in production and long-range prospects are favourable. Introduction of machine processes has reduced the number of hand workers (hand moulders and core makers) while machine operators have increased; this trend is expected to continue.

Wider application of forging is being made at the present time and this is expected to continue. Mechanization and automatic processing have not yet had a marked effect except to reduce the number of material handlers and labourers and it is expected that substitution of machine processes for the skills of hammersmiths and power press operators will be only gradual. With these factors in mind, it is predicted that employment opportunities in forging will be slightly greater than those of the industry as a whole.

In machining occupations, the long-range trend is upwards. Local shortages are expected to occur from time to time and demands will be fairly high. There will be considerable variation in individual job opportunities should developments such as numerically controlled machines be widely adopted: model makers, highly skilled machinists and technicians would be in considerable demand while operators and, to some extent, set-up men and lay-out men would decline. Continuation of the industrialization of Canada also will have the effect of increasing the number of all-round machinists and maintenance workers to keep mechanical equipment in good order. The increasing amount of scientific research being undertaken in Canada has led to a shortage of instrument makers and similar highly skilled machinists; their work is of the type which does not lend itself readily to automatic processes (usually only one type of instrument or model is required) and opportunities for these highly skilled workers will continue with some shortage expected.

In sheet-metal working, employment is related to activity in the construction industry. Although many sheet-metal components are prefabricated and there is a move towards standard sizes, skilled sheet-metal workers are required to cut and fit components because of the wide variety of structural conditions they encounter. Long-range prospects for a fairly high increase in openings is therefore indicated.

Opportunities for welders are also related to activity in the construction industry. In addition, wider application is being made of welding techniques in many other industries. With the continued expansion of the construction industry and of welding processes, demands for welders will continue to be high. In manufacturing industries operators of welding machines, such as resistance welders, are expected to be in demand.

Considerable activity in such fields as electrical power generation, atomic energy, chemical plants and petroleum refineries has created a demand for boilers, heavy tanks and similar containers. However this rise in activity has been offset to some extent by the decline in the use of boilers by railroads. The net result predicted is for a fairly strong demand for boilermakers during the period of construction activity, a period which is expected to extend well into the future.

SEEKING EMPLOYMENT

Young people seeking their first jobs, and older workers wishing to change occupations, can register with the local office of the National Employment Service where they will be given every assistance in locating suitable employment. These offices can also supply much additional information such as employment prospects, working conditions and pay scales in local areas.

Students in vocational and trade schools may obtain assistance from the school placement and guidance officers. In provinces where certain occupations require apprenticeship training, the local apprenticeship authorities are in a position to advise prospective craftsmen on training opportunities.

Job seekers may also apply directly to likely employers without reference to a particular vacancy and employment leads can be obtained from friends and relations already working in the industry. Applications should be made as early as possible since companies usually have a waiting list.

Those intent on becoming well qualified should select companies known to have good training programs. These companies are selective about taking on apprentices or new employees, preferring those with a good educational background or vocational and trade school training and may make it a practice to give preference to applicants who are recommended by their own employees; it may be valuable, therefore, to have friends already in the industry.

EARNINGS

The following listing gives approximate hourly rates prevailing in the industry on a Canada-average basis and should be used for general guidance only. Pay scales frequently change, are subject to geographical differences and vary with the branch of the industry. The reader should refer to the National Employment Service, local employers and union officials or such publications as Wage Rates, Salaries and Hours of Labour in Canada *published by the federal Department of Labour annually, for the current rates in a particular area or branch of the industry.*

PRIMARY IRON AND STEEL

BLAST FURNACES	$	STEEL MAKING	$	ROLLING AND FINISHING	$
Blower	†	Melter	†		
Skip tender	2.52	Charger	2.38	Heater	3.62*
Stove tender	2.78	Steel pourer	2.45	Roller	4.34*
Larryman	2.85	Craneman	2.47	Tongman (rougher)	3.30*
		Craneman (yard)	2.57		

FOUNDRY	$	FORGING	$
Chipper/grinder	1.80	Blacksmith	2.16
Coremaker	1.58 - 1.91	Chipper	1.80
Cupola charger	1.73	Drop-hammer operator	2.55*
Moulder—		Forge-press operator	2.43*
Bench	1.74 - 1.95		
Floor	2.00 - 2.14	* Piece or incentive rates	
Machine	1.80 - 2.05	† Salaried rates	

MACHINING AND RELATED WORK

	$
Machinist—maintenance	2.09 - 2.85
Machinist—production	1.85 - 2.22
Setter	2.21 - 2.25
Lathe operator	1.97 - 2.29
Milling-machine operator	2.10 - 2.22
Machine tender	2.03 - 2.22
Grinder	1.93 - 2.30
Drill-press operator	1.62 - 2.17
Power-shear operator	1.64 - 1.88
Punch-press operator	1.46 - 1.98
Bench fitter/machinist	2.05 - 2.21
Toolmaker (jig or tool)	2.18 - 2.82
Assembler	1.78 - 2.26
Sheet-metal worker	1.77 - 2.30
Inspector	1.96 - 2.30
Boilermaker	2.11

WELDING

	$
Welder—	
Maintenance	2.02 - 2.74
Production	1.71 - 2.25
Machine (production)	2.08 - 2.30
Spot welder	1.89
Flame cutter	2.16

Note

Approximate hours per week (all occupations) 40 to 42. Data: October 1962.

Table 2—Selected Hourly Pay Rates—Canada Average

Table 3—Workers in the Industry

	CANADA		Nfld.		P.E.I.		N.S.		N.B.		Que.		Ont.		Man.		Sask.		Alta.		B.C.		Yukon & N.W.T.
	1951	1961	1951	1961	1951	1961	1951	1961	1951	1961	1951	1961	1951	1961	1951	1961	1951	1961	1951	1961	1951	1961	1961
Furnacemen & heaters, metal (M)	8,028	5,856	8	1	3	1	337	275	21	15	1,668	1,026	4,961	3,460	232	316	31	34	25	70	742	657	1
" " " (F)	12	24	—	—	—	—	—	—	—	1	—	4	12	19	—	—	—	—	—	—	—	—	—
Heat treaters, annealers, temperers (M)	762	1,027	2	1	—	—	8	13	—	2	113	205	607	751	9	12	—	2	1	4	22	37	—
" " " " (F)	—	15	—	—	—	—	—	—	—	—	—	1	—	14	—	—	—	—	—	—	—	—	—
Rolling mill operators (M)	1,701	2,254	—	1	—	—	151	151	1	4	237	308	1,170	1,585	96	82	1	7	6	48	39	68	—
Blacksmith, hammermen, forgemen (M)	9,587	5,135	175	86	103	29	487	235	374	151	3,231	1,661	2,779	1,844	646	334	542	196	608	246	642	342	11
Moulders (M)	9,522	6,700	35	17	10	6	278	169	198	103	2,760	2,298	5,312	3,303	383	296	30	39	119	127	397	341	1
" (F)	20	66	—	—	—	—	—	—	—	—	13	21	6	43	—	—	—	—	—	—	—	2	—
Coremakers (M)	1,885	916	1	3	1	1	33	11	14	16	237	116	1,458	667	61	36	3	4	17	16	60	46	—
" (F)	204	69	—	—	—	—	—	—	12	14	6	4	186	50	—	1	—	—	—	—	—	—	—
Metal drawers & extruders (M)	—	866	—	—	—	—	—	25	—	5	—	234	—	537	—	13	—	6	—	2	—	44	—
" " " (F)	—	63	—	—	—	—	—	—	—	—	—	17	—	43	—	1	—	—	—	—	—	2	—
Metal treating occupations (M)	—	8,917	—	9	—	2	—	325	—	92	—	3,191	—	3,658	—	297	—	51	—	223	—	1,069	—
" " " (F)	—	95	—	—	—	—	—	1	—	1	—	37	—	51	—	—	—	—	—	—	—	4	1
Toolmakers, diemakers (M)	—	10,559	—	1	—	—	—	86	—	20	—	1,826	—	8,298	—	122	—	13	—	37	—	156	—
" " (F)	—	47	—	1	—	—	—	1	—	1	—	7	—	32	—	2	—	1	—	2	—	—	—
Toolmakers, diemakers & setters (M)	9,429	—	1	—	1	—	42	—	18	—	1,569	—	7,571	—	76	—	4	—	29	—	118	—	—
" " " (F)	14	—	—	—	—	—	—	—	—	—	7	—	6	—	1	—	—	—	—	—	—	—	—
Machinists & machine tool setters (M)	—	34,552	—	305	—	38	—	1,031	—	650	—	11,905	—	15,023	—	1,362	—	399	—	1,202	—	2,615	22
Machinists, metal (M)	31,277	—	253	—	14	—	665	—	557	—	8,507	—	16,097	—	1,479	—	317	—	913	—	2,475	—	—
" " (F)	16	—	—	—	—	—	—	—	—	—	—	—	12	—	2	—	—	—	—	—	2	—	—
Filers, grinders, sharpeners (M)	6,746	5,804	79	24	2	1	80	48	86	94	837	922	4,743	3,790	104	117	15	31	53	109	747	663	5
" " " (F)	157	112	—	—	—	—	—	—	4	4	45	28	101	75	—	—	—	1	1	—	6	4	—
Fitters & assemblers, metal (M)	14,780	15,727	19	15	3	3	284	331	165	135	2,242	2,913	11,534	11,536	181	275	18	58	50	107	284	354	—
" " " (F)	1,770	1,876	—	—	—	—	4	1	3	—	170	148	1,565	1,656	8	18	—	1	2	8	18	44	—
Metalworking machine operators (M)	31,121	25,201	54	26	21	6	952	454	364	148	7,221	5,414	20,276	17,509	824	538	140	109	381	300	888	691	6
" " " (F)	3,971	2,952	—	—	—	—	8	4	10	6	860	497	2,996	2,375	22	12	2	5	2	8	71	45	—
Sheet-metal workers (M)	13,299	16,460	173	180	27	21	285	449	225	269	3,139	4,711	6,159	6,679	1,042	1,092	327	530	736	1,145	1,186	1,371	13
" " " (F)	451	642	1	—	—	—	—	1	—	—	66	42	369	580	7	5	1	—	1	5	6	9	—
Riveters and rivet heaters (M)	2,041	1,305	11	1	2	—	179	67	25	18	891	773	722	336	65	36	6	4	30	25	110	45	—
" " " (F)	119	96	—	—	—	—	—	—	—	—	24	16	93	76	—	2	—	—	—	2	2	—	—
Boilermakers, platers and structural metal workers (M)	—	8,533	—	198	—	11	—	645	—	335	—	2,499	—	2,689	—	260	—	123	—	454	—	1,316	3
Boilermakers & platers (M)	4,579	—	105	—	4	—	304	—	248	—	1,140	—	1,437	—	414	—	96	—	209	—	622	—	—
Electroplaters, dip platers & related workers (M)	—	2,004	—	2	—	—	—	30	—	6	—	416	—	1,378	—	71	—	4	—	12	—	83	2
" " " " (F)	—	107	—	—	—	—	—	—	—	—	—	13	—	90	—	1	—	—	—	—	—	3	—
Electroplaters (M)	1,648	—	—	—	8	—	6	—	10	—	342	—	1,189	—	40	—	1	—	7	—	45	—	—
" (F)	80	—	—	—	—	—	—	—	—	—	9	—	69	—	—	—	—	—	—	—	2	—	—
Welders & flame cutters (M)	23,162	37,945	134	314	22	50	674	1,051	340	794	5,675	10,352	11,539	16,865	983	1,544	506	915	1,507	2,779	1,782	3,240	41
" " " (F)	487	770	—	—	—	—	2	—	1	—	225	362	249	380	3	6	—	2	—	2	7	18	—
Polishers & buffers, metal (M)	3,673	2,671	1	1	—	—	12	3	19	14	886	724	2,684	1,806	25	32	—	2	5	16	41	73	—
" " " (F)	140	126	—	—	—	—	—	—	—	1	33	29	101	91	2	—	—	—	—	2	4	3	—
Metalworking occupations, miscellaneous (M)	—	8,675	—	13	—	1	—	183	—	44	—	2,121	—	5,350	—	221	—	63	—	167	—	511	1
" " " (F)	—	1,430	—	—	—	—	—	9	—	3	—	314	—	1,041	—	7	—	2	—	11	—	43	—
Patternmakers (M)	2,287	1,927	12	6	1	—	64	60	37	25	711	498	1,247	1,178	51	39	1	3	26	22	137	96	—
" (F)	24	48	—	—	—	—	1	1	—	—	3	19	19	19	—	—	—	—	—	—	1	9	—
Inspectors, examiners, gaugers, metal (M)	10,344	12,201	8	21	4	5	152	201	74	95	2,378	2,974	7,262	8,002	146	258	25	62	75	240	220	339	4
" " " " (F)	2,516	2,405	—	—	—	—	—	10	1	2	558	547	1,936	1,826	10	6	—	1	2	3	9	10	—
TOTAL	195,771	226,178	1,072	1,226	226	176	5,008	5,871	2,807	3,068	45,803	59,193	116,467	124,705	6,914	7,414	2,066	2,668	4,805	7,394	10,685	14,353	111

(M) = Male
(F) = Female

Source: Census of Canada

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The National Film Board
The Steel Company of Canada Limited

CANADIAN OCCUPATIONS FILMSTRIPS

The Department of Labour has prepared to date, the following occupational filmstrips in collaboration with the National Film Board. A manual has been prepared as an accompaniment to each filmstrip. These may be purchased from the National Film Board, Box 6100, Montreal or from any one of its regional offices.

In Colour .... ***Price $4.00 each***
(In Canada)

Careers in Engineering

Careers in Natural Science

Teacher

Office Occupations

Electronic Computer Occupations

Careers in Library Service

Medical Laboratory Technologist

Electrical and Electronic Occupations

Black-and-White .... ***Price $2.00 each***
(In Canada)

Bricklayer and Stone-Mason

Plumber, Pipefitter and Steamfitter

Sheet-metal Worker

Machine Shop Occupations

Printing Trades

Motor Vehicle Mechanic

The Social Worker

Mining Occupations

Draughtsman

Careers in Home Economics

Careers in Construction

Careers in Meteorology

METAL WORKING OCCUPATIONS
Monograph No. 8

CANADIAN OCCUPATIONS

★

PRINTING TRADES

★

MONOGRAPH 9

DEPARTMENT OF LABOUR, OTTAWA

CANADIAN OCCUPATIONS

★

PRINTING TRADES

MONOGRAPH 9

HON. HUMPHREY MITCHELL, MINISTER
ARTHUR MacNAMARA, C.M.G., LL.D., DEPUTY MINISTER

DEPARTMENT OF LABOUR, OTTAWA

FOREWORD

During recent years there has been a steadily increasing demand for up-to-date information on occupations.

This demand comes from youth faced with the need of choosing an occupation and of selecting the type of training required; from parents, teachers and other counsellors; from workers shifting to other occupations; from employment service officers; from directors of personnel and union officials, and from other quarters.

This series of monographs and an accompanying series of pamphlets, the latter containing similar information in a condensed form, are attempts to meet this demand. No pamphlet is being issued in this case.

These publications represent an expansion of an earlier series issued by the Department of Veterans Affairs to assist members of the armed forces returning to civilian life following the end of the war. These current series, designed for general use, cover a wide range of occupations, including professions. They indicate, among other things, the nature of the occupation or group of occupations, entrance and training requirements, working conditions and opportunities in each.

The monographs have been prepared by our research staff working on occupations, with the generous help and advice of officials of the Unemployment Insurance Commission, Vocational Training Branch and Bureau of Technical Personnel of the Department of Labour, Dominion Bureau of Statistics, Provincial Departments of Education and of Labour, employers' associations, trade unions, professional associations, and other government and non-government bodies.

Grateful acknowledgment is made of this assistance and that obtained from numerous publications on occupations prepared in Canada and in other countries.

DIRECTOR,
Economics and Research Branch,
Department of Labour.

March, 1950.

PRINTING TRADES

Photo N.F.B.

The composing room of a daily paper

HISTORY AND IMPORTANCE

The term "printing" is applied to the art of impressing letters, figures, etc., on paper or other substance. History records that the Chinese, as far back as 868 A.D., duplicated the written word by means of wooden blocks carved in relief. It was not until the fifteenth century, however, when Gutenberg in Germany invented movable type and the hand-operated printing-press, that the way was opened for the rapid growth of the printing art, and the extension of learning and culture to men everywhere.

Up to that time, Europe knew only the hand-written books of the skilled scribe, books which were scarce and expensive. In the printing-press a less expensive medium was found, which permitted a more rapid spread of information. Greek and Roman classics in printed form were soon in general use. Men's minds were stimulated and found expression in the enlightened thinking of the Renaissance.

Printing has rightly been called "the art which preserves all the arts" and the "Mother of Progress". It is difficult to think of any activity in which the printed word does not play a part. It is used not only for social, scientific and cultural purposes, but also for the conduct of government, business and industry. The expansion of free education to all classes during the past century created a greatly increased demand for printed matter.

The present status of the printing industry is largely the result of the new machines and processes that were introduced to it in the nineteenth century which, together with cheaper paper-making methods, so reduced printing costs that the demand for the printed product was greatly stimulated.

One can but briefly review here some of the important changes that took place in that century. The first paper machine making a continuous web of paper was successfully started in England in 1804. A deterrent to the growth of the printing industry was the high cost of paper made from rags. After 1860, the production of paper from wood pulp had a striking effect on the availability of paper, especially newsprint, at reduced costs. Canada, through the development of its vast pulpwood resources, has played a major part in the supplying of newsprint to the printing industry the world over. More than forty nations, including the United States, depend on Canada for most of their newsprint.

Job presses were greatly improved in the second quarter of the nineteenth century; the first rotary press in America appeared in 1865; the linotype and monotype typesetting machines, in the 1880's. Stereotyping, photo-engraving and lithographing processes were also introduced in the nineteenth century, but modern lithography is a quite recent development.

These new machines and processes made for the growth of a highly skilled body of tradesmen who form the backbone of the printing industry.

The printing industry is also important from an economic point of view. In 1946, the last year for which Canadian statistics are available, total production reached a value of $222½ million. There were 2,400 establishments in operation in that year, employing an average of 49,000 workers. Salaries and wages paid out amounted to $86½ million.

It is intended in this monograph to deal mainly with the skilled and semi-skilled trades, which are learned through apprenticeship training. Approximately 60 per cent of the working force of the printing industry is made up of such tradesmen.

Photo N.F.B.

Operating a linotype machine

Printing Methods and Processes

The three principal methods used in printing are letterpress, lithography and gravure. Letterpress is also known as relief printing, lithography as offset printing, and gravure as intaglio or rotogravure.

In letterpress work, the press plate has a raised printing surface, ink being applied only to this surface.

Lithography uses the principle that water and grease repel each other. The printing area is on the same level as the plate and is coated with a greasy substance. Before inking, the whole plate is moistened with water. A greasy ink is used which is absorbed by the greasy printing surface, but is repelled by the water. In the printing process, the image is transferred to an intermediate rubber roller and is then offset on to paper.

In gravure printing, the printing area is below the surface of the plate. The whole plate is inked, then wiped, leaving ink in the depressions only. The ink is applied to paper by suction created in the printing process.

Photo-engraving, electrotyping and stereotyping are complementary to letterpress printing. In photo-engraving, plates are made of copy that cannot be set up in type, such as illustrations. In this process, a photographic negative is printed on a copper or zinc plate, which is treated with a light-sensitive coating, and the plate is then etched with acid to make the illustration stand out in relief.

There are three different ways in which photo-engravings are made. One is the line-etching process. Very little shading is achieved by this method. The second is the half-tone process, which gives finer detail and shading—here the copy to be reproduced is photographed through a fine cross-lined screen, resulting in a negative film on which the image is in the form of dots. On the printing plate the dots, varying in size, stand out in relief. The spacing and size of dots determine the black, shaded or white portions of the picture. The third method, used in gravure printing, is the photogravure process, in which the image is etched below the surface.

Stereotyping and electrotyping are used to make duplicate press plates of type-forms and photo-engravings. Stereotypes are used mainly in newspaper work; electrotypes, which are more durable, in book and magazine work.

In stereotyping a mould is made by pressing a wet papier-mache mat against the type-form. When the mould dries and hardens, molten type metal is poured into it, and the result is a metal casting which is a reproduction of the original type-form.

Duplication is achieved in electrotyping by using a wax or plastic composition, instead of a papier-mache, mould. After receiving the impression of the type-form, the mould is chemically treated. By the process of electrolysis, the mould is coated with a thin film of copper or nickel to form a duplicate of the original. The copper or nickel impression is taken from the mould, backed with lead and mounted, and is then ready for the press.

It may be asked why electrotyping or stereotyping is necessary when the original type-form is available. Rotary presses, used in many plants, require curved plates to fit the cylindrical plate-holders. Type-forms, unlike stereotypes and electrotypes, cannot be used here, since they are flat and cannot be curved. Long runs of magazines, books or newspapers require several plates to preserve a clear print. Again, where several presses are used simultaneously to speed things up, duplicate plates must be used. It is simpler, faster and cheaper to duplicate type-forms by electrotyping and stereotyping than to use several original type-forms.

Letterpress is the most common printing process. It is generally used in newspaper, book and magazine, and commercial work.

Reproduction by lithography is making rapid progress, although it is still less common than letterpress printing. In lithography, plates are made either by photographic (photolithography) or hand methods, although the former predominates. Up until the early 1900's, lithographic work was produced from drawings on stone; since then metal plates have been adopted because they can

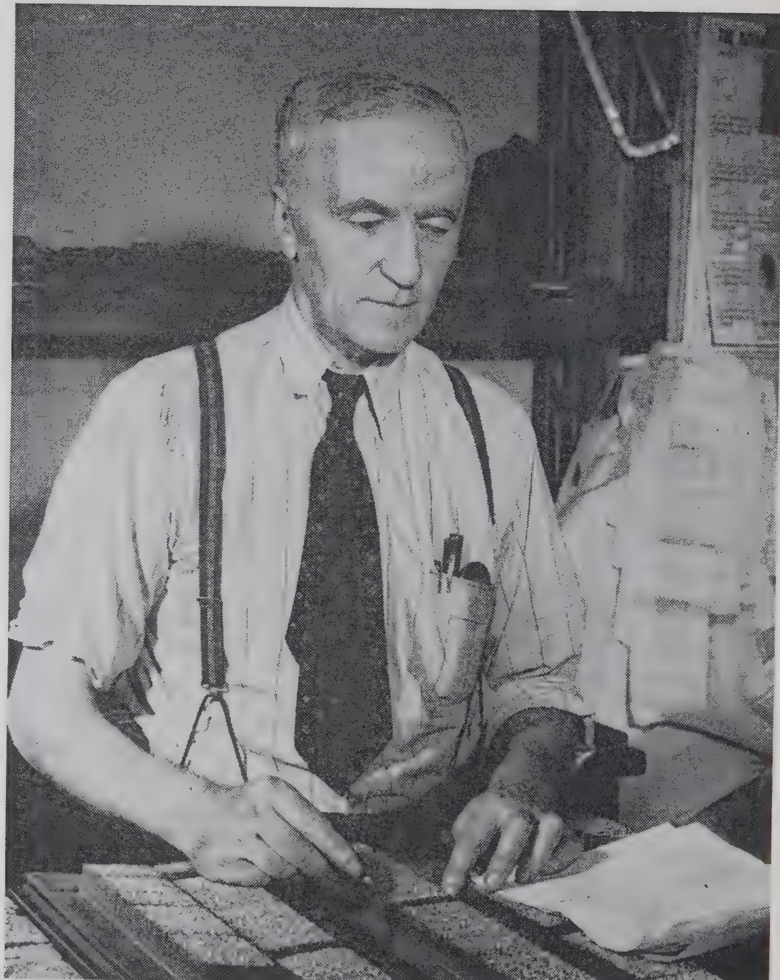

Photo N.F.B.

Making Corrections

be curved to fit the cylinders of a modern lithographic rotary press, which permits speedier production. Lithography is a versatile printing process. It is used for the reproduction of fine art work, maps, books, calendars, posters, labels, office forms, sheet music, etc., and even newspapers. It is said that anything that can be sketched, drawn, or photographed can be lithographed.

Gravure or intaglio printing, the least common process, has two main divisions: rotogravure (pictures are transferred to press plates by photography), and hand or machine engraving. Picture supplements of newspapers are an example of rotogravure work; engraved stationery, greeting cards and like products, of hand or machine engraving. The intaglio method gives finer reproduction than either letterpress or offset. The gravure plate also serves better on long runs than does letterpress, and in rotogravure work this is an advantage. On shorter runs, offset printing has certain advantages over gravure.

Printing Trades

Any printing establishment is concerned essentially with four things: planning, composing, printing, and bookbinding or bindery operations. Emphasis will be placed here on the latter three functions. Within these three areas, there are a large number of occupations which vary from highly skilled to unskilled.

There is a considerable variation in the size of printing plants and in the type of work they produce. There are job or commercial printing plants which range from the one or two-man shop to large establishments using batteries of typesetting machines and presses. This group includes plants capable of producing any type of printed matter. Some job shops specialize in one or more of such printing processes as lithography, photo-engraving, electrotyping and stereotyping. Also within this field are service shops (trade plants) which do specialized work for other printing plants.

In addition there are newspaper establishments, magazine plants and book publishing houses. The two former may also do job work.

In small plants one or two men may carry out all the duties involved in composing, printing, and binding, but in the large plants each of these functions is carried out by special departments, and within each department the work is broken down into a number of specialized operations.

The following is a brief outline of the main skilled and semi-skilled trades that may be found in a printing establishment.

Composing-Room Occupations

The term *compositor*, *typesetter*, or *typographer* applies to anyone who sets type by hand or machine. Before the introduction of the linotype machine, all typesetting was done by hand. Today, however, the machine is to the fore, but hand composing still plays an important part. In some small shops all the type is still set by hand. In many shops machines are used for "straight matter", hand composing or the Ludlow machine for headlines, titles and other display type. It is of primary importance that the apprentice should learn hand typesetting before he proceeds to machine work.

The *hand compositor* sets type by hand, letter by letter, with proper spacing, in a composing "stick". When the stick is full, the lines of type are transferred to a metal tray or "galley". Among other things, he may also, especially in small shops, assemble machine and hand-set type, pull proofs of type-forms, proofread, correct typesetting errors, and do "make-up", that is, arrange type and engravings into pages.

The *linotypist* operates a machine that has a keyboard similar to that of a typewriter but with different arrangement and action. (The intertype machine is similar to the linotype.) After he completes a line of type, the linotypist works a lever and the machine automatically casts the line of type in a solid strip of metal known as a "slug". Each slug is automatically trimmed, and placed in a tray or "galley". The linotype machine is used for newspaper, magazine, book and some job work.

The monotype machine differs from the linotype in that it casts each character separately, whereas the linotype casts a whole line at a time; also the typesetting is done in two steps instead of one. The *monotype keyboard operator* operates a keyboard which punches holes in a paper ribbon. The ribbon is then put through a monotype casting machine by the *monotype caster operator*. This machine casts each character separately, according to the arrangement of holes. The advantages of the monotype machine are that it permits single letter corrections, and makes a better job of spacing letters and words. It also handles tabular matter more efficiently, especially where vertical ruling is required. In the linotype, corrections must be made by entire lines. The latter machine, however, gives a greater rate of production. The monotype machine is used mostly for book and periodical work and for some commercial printing.

The *Ludlow operator* combines hand and machine work. Individual letters or words are set by hand and the Ludlow machine casts them into slugs.

In the larger shops employing a number of typesetting machines, repairs and major adjustments of these are done by a *machinist*.

When all the typesetting is completed and has been placed and arranged in galleys by the *bankman*, proofs are pulled and are checked by *proofreaders* against the original copy for typographical, grammatical or compositional errors. *Copyholders* assist the proofreaders. In small shops, journeymen typesetters and advanced apprentices may do the proofreading. (Galley proofs are also commonly submitted to authors, editors or others responsible for the preparation of copy, before the final make-up of pages takes place.)

After corrections have been made by the compositors, the galleys of type are divided into desired lengths and, together with photo-engraved illustrations, page numbers, etc., are placed on a large, smooth steel-top table, known as a "stone", where they are arranged into pages by the *make-up-man* or *stoneman*. The stoneman then levels the type and locks the completed form in a chase

(a steel rectangular frame), and a final check is made by the *line-up and lock-up man*, who relocks the form in the chase (so that it will lift without spilling any type), after making certain that all type stands firmly upright and level and the margins are correct. The forms are then ready for the press, or for electrotyping or stereotyping.

Journeymen in the composing room, whether "all-round men" or "specialists", are usually trained in all its activities. There is thus a high degree of transferability between jobs in the composing room, especially in small shops.

Photo N.F.B.

Making up a newspaper

Electrotyping and Stereotyping Occupations

There are many service shops which specialize in this type of work for other printing establishments. However, a printing plant may have its own electrotyping and stereotyping department, as is usually the case in newspaper and magazine work.

The processes of electrotyping and stereotyping, as methods of duplicating type-forms, have already been described. In stereotyping the principal trades are:

Stereotype Moulder	—makes the impression of the type-form in the mat (consisting of flong or papier-mache) by means of a press.
Mat Trimmer and Backer	—trims the edges of matrices (impressed mats) and reinforces backs of matrices so that they will not bend during the casting process; dries the matrices under steam pressure.
Stereotype Caster	—operates a machine which pours molten type metal into the mat.
Plate Finisher	—levels stereotype plates, smooths back of plate for mounting, bends plates to cylindrical form for use in rotary presses; routes both flat and circular plates for black and white and colour work.

The main trades in electrotyping are:

Electrotype Mould Builder	—prepares wax and plastic composition moulds.
Electrotype Moulder	—impresses the type or photo-engraved plate forms in moulds.
Batteryman	—operates a plating bath to electroplate copper, lead or nickel on the graphite covered faces of lead, wax, or resinous moulds, to form reproductions, in plate form, of type set-ups for use in printing.
Electrotype Stripper	—removes shells (thin, electrically deposited coatings of copper or nickel) from moulds.

Plate Finisher	—trims and levels electrotype plates, smooths back of plate for mounting, bends plates to cylindrical form for use in rotary presses.
Electrotype Caster	—pours a backing of lead on electroplate shells to strengthen them for use in printing presses.

Photo-engravers

Photo-engravers are mainly engaged in producing plates for letterpress printing, but are also employed in rotogravure work.

The skilled photo-engraver is capable of performing all of the operations involved in the process. In a large service shop, however, the whole job may be done by a number of photo-engravers, each specializing in certain operations, such as photography, printing, etching and finishing.

In letterpress work, the photo-engraver may perform one or more of the tasks involved in reproducing photographs, drawings, paintings, and other illustrations in relief on zinc or copper plates: photographs illustration to make line plate, half-tone, or colour half-tone; develops negatives and sets them in drying oven; strips negatives from photographic plates, places them in reverse position on piece of glass, and sets glass and negative over sensitized metal plate; exposes plate for several minutes; etches plate with acid so that the image stands out in relief; trims and mounts plate; corrects imperfections in the design; prints sample copies to check for errors.

The rotogravure photo-engraver performs work similar to the letterpress photo-engraver. In this case the plate to which the image is transferred, instead of being flat, is a copper cylinder with a highly polished surface.

Lithographic Occupations

Most lithographic work today is done by the photo-lithographic process, although in some types of work, such

as posters, plates are still made by hand. Some of the principal occupations in lithography are:

Lithographic Artist	—copies or creates designs on lithographic stones to be engraved by the "Stone Engraver", using soft, greasy crayons. In photolithography, he retouches negatives or positives by hand with chemicals and dyes. Corrects colours in final press plates.
Stone Engraver	—cuts designs of type or illustration copy into the surface of lithographic stones, using hand and machine tools.
Photolithographer (Cameraman)	—photographs in artificial light either illustration or typeset material to prepare a positive print (or a negative) for use in lithographic printing, enlarging or reducing print (or negative) to desired size. May use screen to break up shadings of copy into dots for half-tone printing. May use colour filters one at a time to prepare various plates for colour printing.
Stripper and Layout Man	—lays out the film or films on a large press-size glass plate or light opaque paper in order to obtain a final layout in accordance with the job specifications.
Transferrer (Press Platemaker)	—transfers images by hand or machine from photographic negatives or positives to zinc plates for printing by the lithographic process. To effect a transfer by hand, the transferrer covers surface of grained zinc plate with a coating of photosensitive chemicals and allows plate to dry; the photographic negative or positive is placed on the plate and an exposure is made under strong artificial light, thus transferring the image from photograph to the plate. In the machine process, photograph and plate are placed in a vacuum frame or photo-

composing machine and an exposure is then made.

After the plate is developed, it is chemically treated, so that when moisture is applied to the press plate, the image areas will receive the greasy ink and the non-image areas will repel it.

A transferrer may also transfer designs from engraved lithographic stones to zinc plates direct or to transparent cellophane sheets for photographing on zinc plates. In the case of the direct transfer, the stone is inked with a special greasy ink and the design transferred to special paper and from the paper to a chemically treated zinc plate by means of a transfer press.

Plate Preparer or Grainer—prepares the faces of zinc or aluminum plates for use as lithographic printing plates by roughening (graining) with a machine which rotates steel or wooden marbles and wet pumice or sharp sand over the surface.

Pressroom Occupations

So far we have traced the work process in printing from the composing room, where the type was set, to the making of press plates by electrotyping, stereotyping, photo-engraving, rotogravure and lithographic processes. The next stage is the pressroom, where the actual printing is done.

The *pressman* operates a press or presses and is responsible for all work involved in printing. His duties include setting the forms or plates in place on the press, "making ready" (running a few samples through the press to ensure that the impression is even, and making final adjustments where necessary), seeing that the flow of ink is correct, and examining press sheets from time to time during the run. The pressman, who must be a journeyman, may be aided by *press assistants* or journeymen (in the case of large, automatic presses), who work under his direction.

There is a distinction between *press assistants* and *press feeders*. In the case of many printing presses, which are equipped with automatic feeders, the position of a press feeder has been largely eliminated and has been replaced by that of the press assistant. These workers are qualified to perform the duties involved in the care and equipment of accessories, loading automatic feeding devices, and assisting in preparing the make-ready. Press assistants may perform any or all of the duties of pressman, under the direction of a journeyman pressman.

Because of the variety of presses and the different methods of printing, the pressman's work varies. In small printing establishments, pressroom workers are usually required to operate more than one type of press and may also set up type by hand. In the larger commercial printing plants, press workers usually specialize in the operation of one kind of press. Some of the main types of press are as follows:[1]

Platen Press	—consists of a frame supporting two flat surfaces—a vertical, stationary surface on which the type-form is locked, and a surface (called the platen) which moves from a horizontal to a vertical position in the printing process. The paper is placed upon the platen and is pressed against the type-form. Platen presses may be hand or automatically fed.
Cylinder Press	—consists of a revolving cylinder, or drum, which carries the paper and is mounted above the flat bed of the press. The type-form is locked on the flat bed and is moved forwards and backwards with a shuttle motion underneath the cylinder. This press may be automatically or hand fed and may be a one or two-colour press.
Rotary Press (Sheet Fed)	—consists of two revolving cylinders, mounted parallel to each other, one carrying the paper, the other the printing plate. The paper is fed either by hand or automatically.

[1] Description of presses adapted from *Pressroom Occupations* in the "Occupational Guide" series issued by the Michigan State Employment Service Division, Detroit, Michigan.

Rotary Press (Roll Fed)	—also known as a web-rotary press and generally used for large quantity printing in newspaper, magazine, and book work. There are two types, one for black-ink printing, the other for colour work. This press is basically a series of synchronized rotary presses which are automatically fed by one or more rolls of paper at a time. The web-rotary press does the complete job of printing: it prints on both sides of the paper; cuts, assembles and folds the pages; counts the number of copies printed. For full production, the web-rotary press requires a crew of five or more workers.

Specially designed rotary presses are used in offset and gravure printing, calling for different techniques.

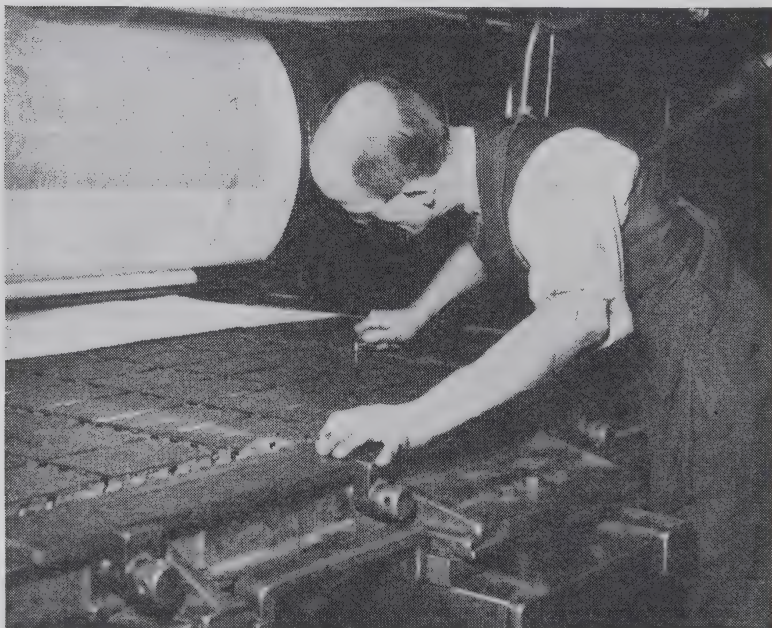

Photo N.F.B.

Trueing up plates on the press

Bindery Occupations

Many printed products, such as newspapers, business forms, labels, etc., require no further work after they leave the press. Books, magazines, pamphlets and folders, however, are put into final form by bindery workers. Many of the bindery jobs are done by journeywomen. Such jobs are folding, gathering sheets or collating sections to form books, operating punching and stitching machines, and hand sewing. Jobs such as hand bookbinding, book finishing, embossing, and operating the more complicated types of machines are usually done by journeymen.

According to the United States Dictionary of Occupational Titles, the skilled bookbinder "performs any or all operations entailed in affixing covers to sewn-together signatures (folded sections of books) to form books or pamphlets, and performs operations entailed in finishing books or pamphlets, such as the following: applies glue to the back of sewn signatures to stiffen back of book body, and forms joint of book covers and book bodies; colours edges of signatures; reinforces backs of books by gluing fabric strips to them; glues cover boards to end sheets and dries books in a press. May tool designs on back covers. May repair books."

QUALIFICATIONS

Entry into the printing trades is almost wholly through apprenticeship. The age at which apprentices are accepted ranges from 16 to about 30. The Apprenticeship Commission in Montreal limits the maximum entry age to 20, with exceptions.

Most of the printing trades call for good eyesight, about average physical strength, and a high degree of manual dexterity. Colour-blindness is a serious handicap in the pressroom, as is left-handedness in the composing room. Some printing trades can be undertaken by those with certain physical handicaps. Workers with speech or hearing defects, or both, have found employment as hand and machine compositors particularly, and in most

of the other printing trades. Some composing-room occupations are suitable for those who have suffered the loss of one or both legs, or who do not have the use of all their fingers. However, use of both hands is almost necessary in all the printing trades. Although there are arrested cases of tuberculosis employed as compositors, these are not common.

Speed with accuracy, mental alertness, neatness, patience, and the ability to work well with others are necessary. An artistic sense is an asset for many kinds of printing work. Perseverance is an essential quality, in view of the long apprenticeship period.

Printing workers, especially compositors and proofreaders, should have a fairly good general education, which includes a good grounding in the English or French language, or both, as the case may be. A high school education is preferred. The usual standard of education stipulated for apprentices is at least two years' high school or its equivalent.

Applicants who have completed a technical or trade school course in a printing trade are more likely to be accepted for apprenticeship than those who are untrained. Technical schools in the larger centres in Canada (e.g. The School of Graphic Arts of the Ryerson Institute, Toronto, and the bilingual l'Ecole des Arts Graphiques, Montreal) offer an industrial course in printing that provides a very useful preparation for apprenticeship. An allowance is usually made for such training and the apprenticeship period correspondingly shortened.

Courses in art, such as drawing, design, colour and lettering can be very helpful for many kinds of printing work.

TRAINING

The provinces of Saskatchewan, Alberta, and New Brunswick (Saint John area only), designate the printing trades for apprenticeship. The Apprenticeship Commission of the printing industry of the Montreal area, which represents both employers and unions, controls

apprenticeship for that area. In Alberta the programme applies only to apprenticeship in weekly newspaper plants.

The length of apprenticeship in the Saint John and Montreal areas is six years; in Saskatchewan, 4,000 hours or six years; and in Alberta (weekly newspapers), four years.

Training programmes in union shops are regulated by unions, in agreement with employers, and vary considerably according to craft and locality. In general, the apprenticeship period lasts from four to six years, depending on the trade. The following summary shows the approximate length of time required for union apprenticeship in the various printing trades:

Compositors (all types)	—5 to 6 years
Electrotypers	—5 to 6 years
Stereotypers	—5 to 6 years
Photo-engravers	
Photographer	—5 to 6 years
Stripper and Printer	—5 to 6 years
Zinc Etcher	—5 to 6 years
Copper Etcher	—5 to 6 years
Router and Blocker	—5 to 6 years
Finisher	—5 to 6 years
Proofer	—5 to 6 years
Tint-Layer	—5 to 6 years
Lithographers	
Process Artist	—4 to 5 years
Stripper and Layout Man	—4 to 5 years
Lithographic Proofer	—4 to 5 years
Photographer	—4 to 5 years
Platemaker	—4 to 5 years
Hand Transferrer	—4 to 5 years
Lithographic Pressman[1]	— 4 years
Opaquer and Tuscher	— 2 years
Stone and Plate Preparer	— 2 years
Press Assistant	— 2 years

[1] The four-years' apprenticeship period is additional to the two years required to become a press assistant.

Pressroom Occupations
(Letterpress and Gravure)

Newspaper Pressman	—5 to 6 years
Commercial Pressman	—5 to 6 years
Pressman Assistant[1]	— 3 years (minimum)

Bindery Occupations

Bookbinder (Male)	—4 to 6 years
Bookbinder (Female)	—2 to 3 years

Training programmes for apprentices are also conducted by employers of non-union and company-union shops.

Apprenticeship training usually includes, in addition to practical work on the job, classroom and correspondence work in related technical and other subjects. In areas where school facilities are not available, the greater part of the training is usually taken in the printing plant. In the Montreal area, in-plant training is complemented by technical instruction given at the Provincial School of Graphic Arts in Montreal.

Because of the continual changes that take place in printing methods and processes, journeymen frequently take further courses to bring themselves up to date. Such training is of particular value to those who wish to become specialists, foremen, supervisors or salesmen.

ENTERING THE OCCUPATION

The ratio of apprentices to journeymen is quite rigidly controlled in the printing trades. It is therefore advisable for the would-be apprentice to get in touch with the appropriate union local and the owners of printing establishments. In this way, he can learn not only what the possibilities for apprenticeship are, but also the specific requirements. The National Employment Service local offices can help an applicant make these contacts.

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[1]An apprentice must serve a period of at least three years before he can qualify as a press assistant. He then has the opportunity of registering as an apprentice pressman and, as such, is required to complete a special apprenticeship course of instruction and an additional two years of intensive training before he obtains his journeyman pressman's status.

EARNINGS

In a recent survey made by the Department of Labour[1], it was found that average wage rates in the daily newspaper industry in 1948 had increased 53 per cent over comparable rates in 1939; the increase in average wage rates in the job printing and publishing industry for this period was 65 per cent.

In this survey returns from 79 establishments across Canada in the daily newspaper industry and 244 establishments in the job printing and publishing industry were used to make a special study of working conditions. The following information, derived from this study, pertains to tradesmen and other non-office workers:

56 and 58 per cent of the workers in the news and job printing fields respectively were covered by collective agreements.

Two-thirds of the workers in the daily newspaper industry were working 40 hours per week or less; 58 per cent were on a five-day week. In job printing, 78 per cent of the workers were on a five-day, 40-hour week. The majority of workers were in establishments reporting time and one-half for overtime during the work-week and double time on Sundays and observed statutory holidays.

Two-thirds of the workers in the daily newspaper field were in establishments reporting a maximum vacation with pay of two weeks, usually after one year of service; almost half of the wage earners in job printing were in establishments reporting a maximum vacation with pay of two weeks, usually after five years of service.

Wage differentials for second and third-shift work were generally paid to tradesmen, ranging in the news printing field from 10 to 17 per cent; in job printing the differential was found to be about 15 per cent.

Average hourly wage rates for certain trades in the daily newspaper and the job printing and publishing industry

[1] See *The Labour Gazette*, August 1949, "Wages, Hours and Working Conditions in the Printing and Publishing Industries, October 1948".

as of October 1948 are presented in the two tables below. Union wage rates prevailing in October 1948 were, in many cases, higher than the average rates shown.

It is to be noted that the average rates quoted here would be currently higher in a number of instances because, among other things, of new collective bargaining agreements made since these rates were compiled.

AVERAGE HOURLY WAGE RATES IN THE DAILY NEWSPAPER INDUSTRY, OCTOBER 1948

Locality	Standard Hours per Week	Average Wage Rate per Hour	
		Compositors Hand and Machine	Pressmen
		$	$
Nova Scotia			
Halifax	40	1.21	1.38
New Brunswick			
Saint John	40	1.20	1.20
Quebec			
Montreal	40	1.52	1.43
Quebec	40	1.09	1.06
Ontario			
Hamilton	44	1.30	1.20
London	40	1.40	1.43
Ottawa	40	1.48	1.48
Toronto	40	1.78	1.78
Windsor	40	1.50	1.50
Manitoba			
Winnipeg	46	1.17	1.19
Saskatchewan			
Regina	44	1.15	1.15
Saskatoon	44	1.26	1.26
Alberta			
Calgary	45	1.30	1.30
Edmonton	44	1.30	1.30
British Columbia			
Vancouver	37½	1.53	1.57
Victoria	37½	1.50	1.50

Source: Department of Labour, *Annual Report on Wage Rates and Hours of Labour in Canada, October, 1948.*

AVERAGE HOURLY WAGE RATES IN THE JOB PRINTING AND PUBLISHING INDUSTRY
OCTOBER 1948

Locality	Standard Hours per Week	Compositors Machine and Hand: Average Wage Rate per Hour	Compositors Machine and Hand: Range of Rates per Hour	Pressmen: Average Wage Rate per Hour	Pressmen: Range of Rates per Hour	Bookbinders: Average Wage Rate per Hour	Bookbinders: Range of Rates per Hour	Bindery Girls: Average Wage Rate per Hour	Bindery Girls: Range of Rates per Hour
		$	$	$	$	$	$	$	$
Nova Scotia									
Halifax........	40–44	.99	.93–1.05	.97	.89–1.00	.81	....	.41	.38– .50
New Brunswick									
Saint John....	40–44	1.06	1.05–1.25	1.02	1.00–1.05	.91	.61–1.02	.40	.34– .46
Quebec									
Quebec........	45	.99	.95–1.05	.97	.88–1.04	.87	.70– .95	.33	.27– .36
Montreal......	40–41	1.30	1.15–1.50	1.19	1.00–1.30	1.17	1.10–1.25	.58	.48– .65
Ontario									
Ottawa........	44–48	1.11	1.01–1.25	1.05	.90–1.14	.95	.75–1.08	.47	.40– .55
Toronto.......	40–44	1.38	1.25–1.55	1.32	1.10–1.40	1.29	1.00–1.35	.71	.50– .75
Hamilton......	40–44	1.35	1.30–1.35	1.34	1.20–1.40	1.26	1.10–1.35	.70	.60– .75
London........	40–44	1.18	.95–1.25	1.22	1.05–1.45	....	....	.50	.45– .60
Windsor.......	40	1.36	1.20–1.45	1.23	1.14–1.35	1.18	.90–1.40	.59	.40– .72
Manitoba									
Winnipeg......	40	1.25	1.15–1.35	1.18	1.00–1.41	1.16	1.00–1.30	.60	.50– .70
Saskatchewan									
Regina........	40	1.31	....	1.27	1.23–1.30	1.10	.91–1.30	.61	.50– .68
Saskatoon.....	40	1.39	1.30–1.48	1.35	1.30–1.40	1.30	....	....	....
Alberta									
Calgary.......	40	1.35	1.30–1.47	1.34	1.30–1.40	....	....	.67	.50– .80
Edmonton......	40	1.33	1.30–1.40	1.34	1.30–1.40	1.30	....	.65	.63– .68
British Columbia									
Vancouver.....	40	1.43	1.28–1.55	1.37	1.15–1.45	1.40	1.18–1.45	.81	.79– .83
Victoria......	40	1.45	....	1.40	1.22–1.45	....	....	.85	....

Source: Department of Labour, *Annual Report on Wage Rates and Hours of Labour in Canada, October, 1948.*

Wage rates for apprentices are based on a percentage of those current for journeymen. They will, therefore, vary according to locality. Apprentices receive graduated increases, in some cases every six months, in others every year, throughout the period of apprenticeship until the maximum is reached.

ADVANCEMENT

Apprentice to journeyman, journeyman to foreman to plant superintendent.

Although the tendency is for tradesmen to remain in the trade for which trained, men in the composing room with a creative flair may become designers and layout men in the advertising field. The man who has leadership ability and who has a thorough knowledge of his department may advance to foreman. A pressman possessing supervisory and managerial qualities, who is well versed in the mechanics of the presses used in all departments, and is acquainted with pricing policies, engraving processes, and other details, may become a plant superintendent.

Firms, such as printing machinery houses, paper companies, and ink manufacturers, sometimes prefer to employ skilled craftsmen as salesmen, or perhaps as technical men, since they are better able to cope with the problems of customers.

There are examples of mechanical men assuming the management of smaller newspapers.

A good number of tradesmen become proprietors of small shops.

ADVANTAGES AND DISADVANTAGES

The printing trades are, in general, strongly organized, which benefits the workers not only in terms of wages and paid vacations, but also in security of tenure. The major printing unions are known for welfare provisions which include pensions, sanatorium facilities and educational programmes.

With some exceptions, the printing trades offer interesting work, especially the skilled occupations. The steady development of new methods and processes adds interest to the work, and encourages further study.

Generally speaking, employment is steady and the standards of pay are good. The printing trades are affected only moderately by seasonal fluctuations and are not as hard hit as many other trades in times of economic depression. There are a variety of highly skilled jobs which a worker can enter, given the opportunity, after reaching journeyman standing.

Another advantage of the printing trades is that, generally speaking, they are insurable occupations and are eligible for unemployment insurance benefits, except for those individual employees who are excluded by reason of their rate of earnings.

Much of the work is exacting and tedious in nature, and would tend to be irritating to one who lacks patience or is nervous in temperament. Certain jobs, such as press feeding, proofreading and bindery work can be very monotonous.

Often the worker is under pressure to meet a time limit. In the newspaper and magazine field night work may be involved, but there is usually the incentive of higher rates for such workers.

Working conditions are good on the whole, but the composing and pressrooms are unavoidably noisy. Although there are the usual occupational hazards associated with machines for bindery, press and other workers, and the slight possibility of lead poisoning in the case of the machine compositors, these can be avoided with proper care. The accident rate is quite low.

LABOUR ORGANIZATIONS

The printing trades are highly organized in Canada, especially in urban areas. As a result, wages, working conditions and hiring policies are strongly influenced by unions. The closed-shop type of agreement is quite common, but there are also a number of printing establish-

ments which are open shops, or in some cases, are covered by a company union.

There are a number of international unions of printing workers in Canada. These are organized by individual crafts; the different trades in lithography, however, are organized in the one union. The situation is slightly different in Quebec where the workers are organized either by the international unions or the national union, this latter union covering all the printing trades.

The reader is referred to the publication "Labour Organization in Canada" prepared by the Department of Labour, Ottawa, for a listing of the national and international printing trade unions and the number and location of their branches.

TRENDS[1]

Growth

An examination of employment figures in the printing and graphic arts industry from 1923 to 1946 (the last year for which figures are available) shows that over this period there was a marked increase in the numbers employed. The labour force in this industry rose from 27,600 in 1923 to 48,950 in 1946, an increase of 77 per cent. Throughout this whole period the trend in employment has been upward, with the exception of the years 1930-33. By 1933 employment had fallen 10 per cent from the 1929 high, but by 1934 the upward trend was resumed and by 1939 the number employed exceeded the 1929 figure by 2,200, representing an increase of 6 per cent. Although the graphic arts industry suffered unemployment during the depression, it recovered quickly and had on the whole less unemployment than most industries in manufacturing. During this period, unions and employers, in order to ensure employment for workers already in the field, exercised strict control over the number of apprentices admitted. The lack of replacements and new entrants

[1] Source of statistical data on printing and graphic arts industry from 1923 to 1946: Dominion Bureau of Statistics, *Report on the Printing Trades in Canada*, 1946.

to take care of retirements and the need for further expansion made itself felt from 1941 through 1943, when the labour force declined very slightly. Towards the end of the war, however, the manpower situation began to ease, and by 1946 the industry had increased its labour force over 1943 by 9,700, representing a rise of close to 25 per cent.

Although the foregoing deals with the total labour force in the printing industry, the growth in the number of skilled and semi-skilled workers directly associated with the printing process was similarly upwards over this period. A comparison of census figures for the years 1921, 1931 and 1941, bears this out. The occupational classification used by the census does not list each printing trade separately but groups the trades into four classes as follows:

Printers	—includes compositors, hand and machine; pressmen — letterpress, lithographic and gravure; electrotypers and stereotypers; and the apprentices to these trades.
Bookbinders	—includes male and female bookbinders, and apprentices.
Engravers and Lithographers	—includes engravers, photo-engravers, lithographers, and apprentices (excluding lithographic and gravure pressmen).

The remaining printing tradesmen, such as certain bindery workers, press feeders, rulers, etc., are grouped together with sundry occupations in photography under the heading "Other Occupations in Printing and Photography". Because of this, separate figures cannot be given for this group of printing occupations. However, it may be assumed that the growth of this group has followed the long-term upward trend of the printing industry as a whole.

The table below indicates the extent of employment in each of the three trade groups at the time the census was taken in 1921, 1931 and 1941; the percentage increase or decrease in numbers between 1921 and 1941 is also shown.

		1921	1931	1941	Percentage Change 1921-41
Printers...........	**Male**	**11,736**	**15,576**	**17,479**	**+ 49**
	Female	**#**	**577**	**827**	**+ 43 (1931-41)**
Bookbinders.......	**Male**	**951**	**822**	**931**	**– 2**
	Female	**1,749**	**1,137**	**1,435**	**– 18**
Engravers and Lithographers.....	**Male**	**1,034**	**1,756**	**2,064**	**+100**
	Female	**#**	**#**	**#**	
TOTAL................		**15,470**	**19,868**	**22,736**	**+ 47**
Total tradesmen and other employees in Printing and Graphic Arts industry.......		**27,610**[1]	**33,919**	**39,866**	**+ 44**

[1] **Number employed in 1923.**

 # Negligible.

The importance of the printers' group of tradesmen from an employment viewpoint stands out sharply in this table: approximately four-fifths of all tradesmen were in this group in 1941.

The decline in the number of bookbinders was much less severe for males than for females.

Few women were employed as engravers and lithographers. In 1941 there were fewer than 100 so employed. The increasing use of engraving and, more particularly, of the lithographic process is reflected in the 100 per cent rise in employment for engravers and lithographers that occurred between 1921 and 1941. It may be expected that still greater use will be made of the lithographic process, with the result that more opportunities will be created in this field.

Geographic Distribution

The heavy concentration of printing employees in the central provinces is evident from the following table, which shows the distribution of these by province in 1946. More than three-quarters of the gainfully occupied were employed in Quebec and Ontario, employment in Ontario being double that of Quebec.

DISTRIBUTION BY PROVINCE OF ALL EMPLOYEES IN THE PRINTING AND GRAPHIC ARTS INDUSTRY, 1946

	Male	Female	Total	Per Cent Distribution
Canada	34,617	14,333	48,950	100.0
P.E.I.	97	52	149	0.3
N.S.	835	392	1,227	2.5
N.B.	422	198	620	1.3
Que.	9,330	3,012	12,342	25.2
Ont.	17,195	8,248	25,443	52.0
Man.	2,169	912	3,081	6.4
Sask.	887	292	1,179	2.4
Alta.	1,130	399	1,529	3.2
B.C. and Yukon	2,552	828	3,380	6.7

The regional distribution of the three printing trade groups for 1941 shows the same pronounced concentration of tradesmen in the central provinces. The disparity in distribution is even more accentuated in the case of bookbinders, engravers and lithographers.

PERCENTAGE DISTRIBUTION OF PRINTING TRADESMEN BY REGION, 1941

Trade Group	Maritimes	Quebec	Ontario	Prairie Prov.	B.C.
Printers	4.7	26.1	48.2	13.5	7.5
Bookbinders	2.5	31.5	50.0	9.6	6.4
Engravers and Lithographers	1.5	26.0	59.5	6.9	6.1

As is to be expected, the majority of printing tradesmen are to be found in the larger urban centres. In 1941, fourteen of the largest cities in Canada together accounted for the employment of 54 per cent of all printers, 70 per cent of all bookbinders, and 66 per cent of all engravers and lithographers. The two cities of Toronto and Montreal bulk large in this employment picture. Together they employed over 31 per cent of all gainfully occupied printers in 1941, 45 per cent of all bookbinders and 42 per cent of all engravers and lithographers. Winnipeg and Vancouver rank next in the matter of employment of printing tradesmen.

PERCENTAGE DISTRIBUTION OF PRINTING TRADESMEN BY SELECTED CITIES, 1941

	Printers	Bookbinders	Engravers and Lithographers
Toronto	17.4	28.4	26.7
Montreal	14.0	18.6	15.7
Winnipeg	4.2	4.3	3.6
Vancouver	4.0	3.7	4.6
14 largest cities	53.7	70.2	66.3

In a survey carried out by the Department of Veterans Affairs in late 1946, it was estimated that hand and machine compositors formed roughly 42 per cent of the total in the printing trades in Canada. The proportion of typographers in Ontario was estimated at 30 per cent. The greater use of the linotype machine and of stereotyping and electrotyping accounted for this lower proportion. About 63 per cent of all typographers were in Quebec and Ontario.

The survey brought out that 77 per cent of all pressmen were in the two central provinces. The reason for this concentration is that most of the books, magazines and large-circulation newspapers in Canada are printed in these areas, requiring the use of multiple presses for the same copy and illustrations.

Industrial Distribution

The mass of employment of printing workers is in the printing and publishing field. The following table gives the industrial distribution for all printing employees in 1946, and provides some idea of the distribution of printing tradesmen for that year.

NUMBER OF EMPLOYEES AND ESTABLISHMENTS, BY INDUSTRY, 1946

Industry	Establishments	Employees
Printing and Publishing	775	21,462
Printing and Bookbinding	1,406	19,376
Lithography	48	3,696
Engraving, stereotyping and electrotyping	111	3,675
Trade Composition	39	522
Blue Printing	25	219
TOTAL	2,404	48,950

A better idea of the industrial distribution of tradesmen can be had from the 1941 census. In that year the printing, publishing and engraving industry accounted for the employment of 88.3 per cent of all gainfully occupied printers, 82.9 per cent of bookbinders, and 63.6 per cent of engravers and lithographers. It is worth noting that 10.5 per cent of engravers and lithographers were employed in the photographic field, and roughly 1.4 per cent in advertising.

PERCENTAGE DISTRIBUTION OF PRINTING TRADESMEN, BY INDUSTRY, 1941

	Printing Pub. and Engraving	Paper Products Mfg.	Photography	Trade	Service Govt.	Service Other	Sundry
Printers........	88.3	3.1	#	1.2	1.4	1.1	4.9
Bookbinders...	82.9	4.1	Nil	3.4	1.8	4.4	3.4
Engravers and Lithographers..	63.6	2.4	10.5	3.4	1.0	1.9(x)	17.2

Negligible.
(x) Includes 1.4 per cent in advertising.

Approximately 380 foremen were shown as employed in printing, publishing and engraving in 1941.

Age Distribution

An examination of the distribution of printing tradesmen by age in the year 1941 shows that male bookbinders had a larger proportion (26.3 per cent) in the upper age bracket (55 and over) than the other printing trade groups. Male engravers and lithographers came next with 16.5 per cent, followed by printers with 14.4 per cent. In the case of printers, the proportion would probably be higher today then in 1941, since in that year 17.2 per cent were in the age group 45 to 54.

Women were mostly represented in the age groups up to 44.

It can be seen, from the foregoing, that there will probably be at least a moderate number of openings occurring as a result of retirements and deaths in the case of printing tradesmen. Openings for women because

of these factors will be very few. However, openings occasioned by turnover because of the marriage factor would be fairly high for women.

AGE DISTRIBUTION OF PRINTING TRADESMEN, 1941
(Percentages)

	Under 45	45-54	55 +
Bookbinders			
Male	53.8	19.9	26.3
Female	86.2	7.8	6.0
Engravers and Lithographers			
Male	67.0	16.5	16.5
Female	100.0	—	—
Printers			
Male	68.4	17.2	14.4
Female	84.3	11.0	4.7

Employment Prospects

For the greater part of 1948, according to National Employment Service figures, the number of unfilled vacancies for skilled and semi-skilled male workers in printing and publishing was more or less equal to the number of unplaced applicants, which would indicate a firm demand for such workers. From October 1948 to October 1949, the number of applicants exceeded that of vacancies, which may point to a slight softening of demand. It is noted that the number of vacancies for male workers gradually declined in 1948 as the year progressed. A low of 108 vacancies compared with a high of 317 applicants was recorded at the beginning of March. From March onward the situation improved. On September 29, 1949, there were 201 unfilled vacancies compared with 413 unplaced applicants.

Corresponding figures for females show a consistent excess of applicants over vacancies through 1948 and early 1949. On September 29, 1949, the figures were 15 unfilled vacancies as against 194 unplaced applicants.

The present demand for unskilled workers, both male and female, is low.

The foregoing does not give a complete picture of current demand and supply since, in the case of skilled and semi-skilled workers, an appreciable part of the placement would be done by the printing unions themselves.

It has been pointed out that the long-term trend in employment of tradesmen has been steadily upward in most printing occupations. The likelihood is that this trend will be maintained in the future. At the same time, it would seem that the rate of increase in employment, which was high in the late war years and in the post-war period, has probably reached its peak and may revert to a lower figure.

Mention has been made of the high proportion of tradesmen in the central provinces and in the larger cities. Because of this, openings should be more plentiful and of greater variety in these areas than elsewhere. This should hold, in greater degree, for engravers, lithographers and bookbinders than for the printers' group of tradesmen. In the latter case, although there is a concentration of such tradesmen in the larger cities, it is not as marked as for the other tradesmen—there are many small-town printing shops which publish weeklies and do job work. It can be expected, of course, that competition for jobs in the printing trades will be keenest in the large cities.

The postponement of retirements during and since the war, and the fact that the average age of journeymen is therefore higher than before, should produce a greater need for replacements on this account over the next few years. The mortality factor should also add to this need.

The majority of printing tradeswomen are employed in bookbinding occupations; relatively few in the other trades.

Approximately four-fifths of all printing tradesmen are to be found in the printers' group of occupations (compositors, pressmen, electrotypers and stereotypers). The majority of openings will, therefore, probably occur in this field. Within this group, the long-range outlook is more favourable for machine compositors than for hand

compositors; there will probably continue to be a slow decline in hand composing, largely because of the greater use of machine typesetting. The likelihood is that the greatest number of opportunities will be in machine composing and press work. Monotype keyboard operation, monotype casting, electrotyping and stereotyping are expanding fields, but the number of openings that may occur here will be considerably fewer than for linotype operators and pressmen. Some expansion should also occur in the photo-engraving field.

Many United States periodicals are printed in Canada for Canadian circulation because of tariff restrictions. This trend is favourable to pressmen, since this kind of printing, apart from local advertising, is done from stereotyped or electrotyped plates prepared by the original publisher. Other United States publications come into Canada direct and are sold at higher prices. If their circulation should fall off, it is probable that there would be Canadian-printed editions to restore it, which action would be favourable to pressmen in Canada.

The increasing use of illustration work in advertising, particularly colour work, should benefit the lithographic trades. The effect of an economic recession would be felt keenly by these trades. Although lithography is the fastest growing printing process, the actual number of openings for newcomers, in the foreseeable future, will probably not be large. Men with experience in, or training related to, lithographic work stand a much better chance of filling the new openings that will occur.

Bookbinding has, in the process of mechanization, become an occupation needing a smaller proportion of fully skilled workers. The trade is dependent upon the demand for books and is directly affected by economic conditions. The long-term trend for skilled bookbinders will probably continue downward. Men have a tendency to make bookbinding a lifetime job, so that the rate of turnover is low in this occupation.

Seasonal unemployment is not very common in the printing trades, the number of workers employed throughout the year being quite consistent. Adverse economic

conditions affect certain types of printing more than others, less so in the newspaper field and more so in the job printing field. A high level of business makes for a high demand for printed products and advertising materials; consequently, printing tradesmen who are employed in establishments dependent on this demand are more affected by a low business level.

Some consideration must be given to the probable effects of technological changes in opportunities for printing tradesmen. In the past few years, the character of the work, together with the specific types of jobs performed, has changed. The introduction of the composing machine has resulted in fewer jobs for hand compositors. Advances in presses have changed the character of the pressman's work. There has been rapid improvement in the offset printing process, both in reproduction and in presses. The gravure process is considered by some authorities to be one which will be more widely used. The increasing use of colour printing makes it probable that there will be a greater demand in the next few years for printers who are skilled in colour process work.

A new process that is being developed rapidly is the silk-screen process, which is used widely in the textile industry, in sign shops, in department stores for display purposes, and even on small runs by lithographers. It is considered to be one of the most artistic and versatile processes now available.

There have been important changes recently in typesetting, which if generally used would possibly tend to reduce the need for linotype operators; examples of these are the semagraph and teletypesetter.

The introduction of changes has, in the past, been gradual. Their effects on future employment prospects must, however, be considered.

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AUDIO-VISUAL MATERIAL

Readers desiring information on film sources, available material, and the organization of local film services may obtain it from National Film Board offices as listed in Monograph 1, "Carpenter".

LOCAL INFORMATION

DEPARTMENT OF LABOUR

Economics and Research Branch

OTTAWA, 1950

OTTAWA
EDMOND CLOUTIER, C.M.G., B.A., L.PH.,
KING'S PRINTER AND CONTROLLER OF STATIONERY

CANADIAN OCCUPATIONS

★

PRINTING TRADES

MONOGRAPH 9

REVISED 1957

DEPARTMENT OF LABOUR, CANADA

CANADIAN OCCUPATIONS

★

PRINTING TRADES

MONOGRAPH 9

REVISED 1957

HON. MILTON F. GREGG, V.C., MINISTER
A. H. BROWN, DEPUTY MINISTER

DEPARTMENT OF LABOUR, CANADA

PRINTED IN CANADA

45

Price: 10 cents

FOREWORD

During recent years there has been a steadily increasing demand for up-to-date information on occupations.

This demand comes from youth faced with the need of choosing an occupation and of selecting the type of training required; from parents, teachers and other counsellors; from workers shifting to other occupations; from employment service officers; from directors of personnel and union officials, and from other quarters.

This series of monographs and an accompanying series of pamphlets, the latter containing similar information in a condensed form, are attempts to meet this demand. These publications are designed for general use and cover a wide range of occupations, including professions. They indicate, among other things, the nature of the occupation or group of occupations, entrance and training requirements, working conditions and opportunities in each.

The staff of the Occupational Analysis Section has prepared this series with the generous assistance of representatives of management, trade unions and professional associations. The co-operation of the Unemployment Insurance Commission, the Vocational Training Branch of the Department of Labour, and the Dominion Bureau of Statistics is gratefully acknowledged.

Acknowledgment is also made of the assistance obtained from numerous publications on occupations prepared in Canada and in other countries.

DIRECTOR,
Economics and Research Branch,
Department of Labour.

January 1957.

CONTENTS

PRINTING TRADES

Photo: N.F.B.

The composing room of a daily paper

HISTORY AND IMPORTANCE

The term "printing" is applied to the art of impressing letters, figures, etc., on paper or other substance. History records that the Chinese, as far back as 868 A.D., duplicated the written word by means of wooden blocks carved in relief. It was not until the fifteenth century, however, when Gutenberg in Germany invented movable type and the hand-operated printing-press, that the way was opened for the rapid growth of the printing art, and the extension of learning and culture to men everywhere.

Up to that time, Europe knew only the hand-written books of the skilled scribe, books that were scarce and expensive. In the

printing-press a less expensive medium was found, which permitted a more rapid spread of information. Greek and Roman classics in printed form were soon in general use. Men's minds were stimulated and found expression in the enlightened thinking of the Renaissance.

Printing has rightly been called "the art which preserves all the arts" and the "Mother of Progress". It is difficult to think of any activity in which the printed word does not play a part. It is used not only for social, scientific and cultural purposes, but also for the conduct of government, business and industry. The expansion of free education to all classes during the past century created a greatly increased demand for printed matter.

The present status of the printing industry is largely the result of new machines and processes introduced in the nineteenth century. These, together with cheaper paper-making methods, so reduced printing costs that the demand for the printed product was greatly stimulated.

One can but briefly review here some of the important changes that took place in that century. The first paper machine making a continuous web of paper was successfully started in England in 1804. A deterrent to the growth of the printing industry was the high cost of paper made from rags. After 1860, the production of paper from wood pulp had a striking effect on the availability of paper, especially newsprint, at reduced costs. Canada, through the development of its vast pulpwood resources, has played a major part in the supplying of newsprint to the printing industry the world over. More than forty nations, including the United States, depend on Canada for most of their newsprint.

Job presses were greatly improved in the second quarter of the nineteenth century; the first rotary press in America appeared in 1865; the linotype and monotype typesetting machines, in the 1880's. Stereotyping, photo-engraving and lithographing processes were also introduced in the nineteenth century, but modern lithography is a quite recent development.

These new machines and processes made for the growth of a highly skilled body of tradesmen who form the backbone of the printing industry.

The printing industry is also important from an economic standpoint. In 1954, the last year for which Canadian statistics

are available, total production reached a value of slightly more than \$525½ million. During the year, 2,841 establishments were in operation, employing about 63,200 workers. Salaries and wages paid out amounted to approximately \$209 million.

It is intended in this monograph to deal mainly with the skilled and semi-skilled trades, which are learned through apprenticeship training. Approximately 60 per cent of the working force of the printing industry is made up of such tradesmen.

FIELD AND NATURE OF WORK

Printing Methods and Processes

The three principal methods used in printing are letterpress, lithography and gravure. Letterpress is also known as relief print-

Photo: N.F.B.

Operating a linotype machine

ing, lithography as offset printing, and gravure as intaglio or rotogravure.

In letterpress work, the press plate has a raised printing surface, ink being applied only to this surface.

Lithography uses the principle that water and grease repel each other. The printing area is on the same level as the plate and is coated with a greasy substance. Before inking, the whole plate is moistened with water. A greasy ink is used which is absorbed by the greasy printing surface, but is repelled by the water. In the printing process, the image is transferred to an intermediate rubber roller and is then offset on to paper.

In gravure printing, the printing area is below the surface of the plate. The whole plate is inked, then wiped, leaving ink in the depressions only. The ink is applied to paper by suction created in the printing process.

Photo-engraving, electrotyping and stereotyping are complementary to letterpress printing. In photo-engraving, plates are made of copy that cannot be set up in type, such as illustrations. In this process, a photographic negative is printed on a copper or zinc plate, which is treated with a light-sensitive coating, and the plate is then etched with acid to make the illustration stand out in relief.

There are three different ways in which photo-engravings are made. One is the line-etching process. Very little shading is achieved by this method. The second is the half-tone process, which gives finer detail and shading — here the copy to be reproduced is photographed through a fine cross-lined screen, resulting in a negative film on which the image is in the form of dots. On the printing plate the dots, varying in size, stand out in relief. The spacing and size of dots determine the black, shaded or white portions of the picture. The third method, used in gravure printing, is the photogravure process, in which the image is etched below the surface.

Stereotyping and electrotyping are used to make duplicate press plates of type-forms and photo-engravings. Stereotypes are used mainly in newspaper work; electrotypes, which are more durable, in book and magazine work.

In stereotyping, a mould is made by pressing a wet papier-mâché mat against the type-form. When the mould dries and hardens, molten type metal is poured into it, and the result is a metal casting which is a reproduction of the original type-form.

Duplication is achieved in electrotyping by using a wax or plastic composition, instead of a papier-mâché, mould. After receiving the impression of the type-form, the mould is chemically treated. By the process of electrolysis, the mould is coated with a thin film of copper or nickel to form a duplicate of the original. The copper or nickel impression is taken from the mould, backed with lead and mounted, and is then ready for the press.

It may be asked why electrotyping or stereotyping is necessary when the original type-form is available. Rotary presses, used in many plants, require curved plates to fit the cylindrical plate-holders. Type-forms, unlike stereotypes and electrotypes, are not used here, since they are flat and cannot be curved. Long runs of magazines, books or newspapers require several plates to preserve a clear print. Again, where several presses are used simultaneously to speed things up, duplicate plates must be used. It is simpler, faster and cheaper to duplicate type-forms by electrotyping and stereotyping than to use several original type-forms.

Letterpress is the most common printing process. It is generally used in newspaper, book and magazine, and commercial work.

Reproduction by lithography is making rapid progress, although it is still less common than letterpress printing. In lithography, plates are made either by photographic (photolithography) or hand methods, although the former predominates. Up until the early 1900's, lithographic work was produced from drawings on stone; since then metal plates have been adopted because they can be curved to fit the cylinders of a modern lithographic rotary press, which permits speedier production. Lithography is a versatile printing process. It is used for the reproduction of fine art work, maps, books, calendars, posters, labels, office forms, sheet music, etc., and even newspapers. It is said that anything that can be sketched, drawn, or photographed can be lithographed.

Gravure or intaglio printing, the least common process, has two main divisions: rotogravure (pictures are transferred to press

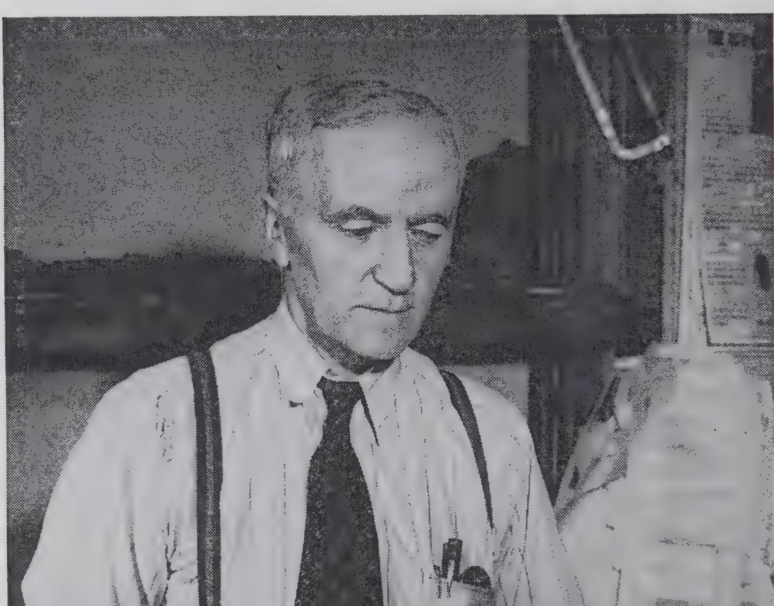

Photo: N.F.B.

Making Corrections

plates by photography), and hand or machine engraving. Picture supplements of newspapers are an example of rotogravure work; engraved stationery, greeting cards and like products, of hand or machine engraving. The intaglio method gives finer reproduction than either letterpress or offset. The gravure plate also serves better on long runs than does letterpress, and in rotogravure work this is an advantage. On shorter runs, offset printing has certain advantages over gravure.

Printing Trades

Any printing establishment is concerned essentially with four things: estimating and planning, composing, printing, and book-binding or bindery operations. Emphasis will be placed here on the latter three functions. Within these three areas, there are a large number of occupations which vary from highly skilled to unskilled.

There is a considerable variation in the size of printing plants and in the type of work they produce. There are job or commercial printing plants which range from the one or two-man shop to large establishments using batteries of typesetting machines and presses. This group includes plants capable of producing any type of printed matter. Some job shops specialize in one or more of such printing processes as lithography, photo-engraving, electro-typing and stereotyping. Also within this field are service shops (trade plants), which do specialized work for other printing plants.

In addition there are newspaper establishments, magazine and book publishing houses. The two former may also do job work.

In small plants one or two men may carry out all the duties involved in composing, printing, and binding, but in the large plants each of these functions is carried out by special departments, and within each department the work is broken down into a number of specialized operations.

The following is a brief outline of the main skilled and semi-skilled trades that may be found in a printing establishment.

Composing-Room Occupations

The term *compositor, typesetter,* or *typographer* applies to anyone who sets type by hand or machine. Before the introduction of

the linotype machine, all typesetting was done by hand. Today, however, the machine is to the fore, but hand composing still plays an important part. In some small shops all the type is still set by hand. In many shops, machines are used for "straight matter", and headlines, titles and other display type are set by hand or with the Ludlow machine. It is of primary importance that the apprentice learn hand typesetting before he proceeds to machine work.

The *hand compositor* sets type by hand, letter by letter, with proper spacing, in a composing "stick". When the stick is full, the lines of type are transferred to a metal tray or "galley". Among other things, he may also, especially in small shops, assemble machine and hand-set type, pull proofs of type-forms, proofread, correct typesetting errors, and do "make-up", that is, arrange type and engravings into pages.

The *linotypist* operates a machine that has a keyboard similar to that of a typewriter but with different arrangement and action. (The Intertype machine is similar to the linotype.) After he completes a line of type, the linotypist works a lever and the machine automatically casts the line of type in a solid strip of metal known as a "slug". Each slug is automatically trimmed, and placed in a galley. The linotype machine is used for newspaper, magazine, book and some job work.

The monotype machine differs from the linotype in that it casts each character separately instead of a line at a time; also the typesetting is done in two steps instead of one. The *monotype keyboard operator* operates a keyboard that punches holes in a paper ribbon. The ribbon is then put through a monotype casting machine by the *monotype caster operator*. This machine casts each character separately, according to the arrangement of holes. The advantages of the monotype machine are that it permits single letter corrections, and makes a better job of spacing letters and words. It also handles tabular matter more efficiently, especially where vertical ruling is required. In the linotype, corrections must be made by entire lines. The latter machine, however, gives a greater rate of production. The monotype machine is used mostly for book and periodical work and for some commercial printing.

The *Ludlow operator* combines hand and machine work. Individual letters or words are set by hand and the Ludlow machine casts them into slugs.

When all the typesetting is completed and has been placed and arranged in galleys by the *bankman,* proofs are pulled and are checked by *proofreaders* against the original copy for typographical, grammatical or compositional errors. *Copyholders* assist the proofreaders. In small shops, journeymen typesetters and advanced apprentices may do the proofreading. (Galley proofs are also commonly submitted to authors, editors or others responsible for the preparation of copy, before the final make-up of pages takes place.)

After corrections have been made by the compositors, the galleys of type are divided into desired lengths and, together with

Photo: N.F.B.

Making up a newspaper

photo-engraved illustrations, page numbers, etc., are placed on a large, smooth steel-top table, known as a "stone", where they are arranged into pages by the *make-up man*. The *stoneman* then levels the type and locks the completed form in a chase (a steel rectangular frame). A final check is made by the *line-up* and *lock-up man,* who relocks the form in the chase (so that it will lift without spilling any type), after making certain that all type stands firmly upright and level and the margins are correct. The forms are then ready for the press, or for electrotyping or stereotyping.

Journeymen in the composing room, whether "all-round men" or "specialists", are usually trained in all its activities. There is thus a high degree of transferability among jobs in the composing room, especially in small shops.

Electrotyping and Stereotyping Occupations

Many service shops specialize in this type of work for other printing establishments. However, a printing plant may have its own electrotyping and stereotyping department, as is usually the case in newspaper and magazine work.

The processes of electrotyping and stereotyping, as methods of duplicating type-forms, have already been described. In stereotyping the principal trades are:

Stereotype Moulder	— makes the impression of the type-form in the mat (consisting of flong or papier-mâché) by means of a press.
Mat Trimmer and Backer	— trims the edges of matrices (impressed mats) and reinforces backs of matrices so that they will not bend during the casting process; dries the matrices under steam pressure.
Stereotype Caster	— operates a machine that pours molten type metal into the mat.
Plate Finisher	— levels stereotype plates, smooths back of plate for mounting, bends plates to cylindrical form for use in rotary presses; routes both flat and circular plates for black and white and colour work.

The main trades in electrotyping are:

Electrotype Mould Builder	— prepares wax and plastic composition moulds.
Electrotype Moulder	— impresses the type or photo-engraved plate forms in moulds.
Batteryman	— operates a plating bath to electroplate copper, lead or nickel on the graphite covered faces of lead, wax, or resinous moulds, to form reproductions, in plate form, of type set-ups for use in printing.
Electrotype Stripper	— removes shells (thin, electrically deposited coatings of copper or nickel) from moulds.
Plate Finisher	— trims and levels electrotype plates, smooths back of plate for mounting, bends plates to cylindrical form for use in rotary presses.
Electrotype Caster	— pours a backing of lead on electroplate shells to strengthen them for use in printing presses.

Photo-engravers

Photo-engravers are mainly engaged in producing plates for letterpress printing, but are also employed in rotogravure work.

The skilled photo-engraver is capable of performing all of the operations involved in the process. In a large service shop, however, the whole job may be done by a number of photo-engravers, each specializing in certain operations, such as photography, printing, etching and finishing.

In letterpress work, the photo-engraver may perform one or more of the tasks involved in reproducing photographs, drawings, paintings, and other illustrations in relief on zinc or copper plates: photographs illustrations to make line plate, half-tone, or colour half-tone; develops negatives and sets them in drying oven; strips negatives from photographic plates, places them in reverse position on piece of glass, and sets glass and negative over sensitized metal plate; exposes plate for several minutes; etches plate with acid so that the image stands out in relief; trims and mounts plate; corrects imperfections in the design; prints sample copies to check for errors.

The rotogravure photo-engraver performs work similar to the letterpress photo-engraver. In this case, the plate to which the image is transferred, instead of being flat, is a copper cylinder with a highly polished surface.

Lithographic and Photo-offset Occupations

In lithography, plates are made either by photographic or hand methods. The photographic process is the more common and is known as photolithography or photo-offset. In some types of work, plates are still made by hand.

What goes into the making of a press plate? First of all, designs or type can be transferred to zinc press plates either from lithographic stones (made of limestone) or from photographic positives or negatives. This is done by the *transferrer* or *press platemaker*.

The *transferrer* covers the surface of the grained zinc plate with a coating of photosensitive chemicals and allows it to dry; the photographic negative or positive is placed on the plate and an exposure is made, thus transferring the image from the photograph to the plate. After the plate is developed, it is chemically treated, so that when the plate is moistened, the image areas will absorb the greasy ink and the non-image areas will repel it.

The process of transferring from lithographic stones can be done directly or by photography. The photographic method is similar to the one described above. In the direct method, the stone is inked with a special greasy ink and the design transferred to special paper and then to the press plate by means of a transfer press.

The *lithographic artist* draws designs on lithographic stones and, in photolithography, retouches negatives or positives by hand. He also corrects colours in final press plates. The *stone engraver,* using hand tools, cuts designs of type or illustration into the surface of lithographic stones. The *cameraman* or *photolithographer* photographs, in artificial light, either illustration or typeset material to prepare a positive print (or negative) for use in making plates. The *stripper* and *layout man* lays out the film or films on a large press-size glass plate or light opaque paper in order to make a final layout in accordance with the job specifications.

Pressroom Occupations

So far we have traced the work process in printing from the composing room, where the type was set, to the making of press plates by electrotyping, stereotyping, photo-engraving, rotogravure and lithographic processes. The next stage is the pressroom, where the actual printing is done.

The *pressman* operates a press or presses and is responsible for all work involved in printing. His duties include setting the forms or plates in place on the press, "making ready" (running a few samples through the press to ensure that the impression is even, and making final adjustments where necessary), seeing that the flow of ink is correct, and examining press sheets from time to time during the run. The pressman, who must be a journeyman, may be aided by *press assistants,* or other journeymen (in the case of large, automatic presses), who work under his direction.

There is a distinction between *press assistants* and *press feeders.* Many printing presses are now equipped with automatic feeders so that press feeders have been largely eliminated and replaced by press assistants. These workers are qualified to perform the duties involved in the care of equipment and accessories, loading automatic feeding devices, and assisting in preparing the make-ready. Press assistants may perform any or all of the duties of pressman, under the direction of a journeyman pressman.

Because of the variety of presses and the different methods of printing, the pressman's work varies. In small printing establishments, pressroom workers are usually required to operate more than one type of press and may also set up type by hand. In the larger commercial printing plants, press workers usually specialize in the operation of one kind of press. Some of the main types of press are as follows:[1]

Platen Press — consists of a frame supporting two flat surfaces —a vertical, stationary surface on which the type-form is locked, and a surface (called the platen) that moves from a horizontal to a vertical position in the printing process. The paper is placed upon the platen and is pressed against the type-form: Platen presses may be hand or automatically fed.

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[1] Description of presses adapted from *Pressroom Occupations* in the "Occupational Guide" series issued by the Michigan State Employment Service, Detroit, Michigan.

Cylinder Press — consists of a revolving cylinder, or drum, that carries the paper and is mounted above the flat bed of the press. The type-form is locked on the flat bed and is moved forwards and backwards with a shuttle motion underneath the cylinder. This press may be automatically or hand fed and may be a one or two-colour press.

Rotary Press (Sheet Fed) — consists of two revolving cylinders, mounted parallel to each other, one carrying the paper, the other the printing plate. The paper is fed either by hand or automatically.

Rotary Press (Roll Fed) — also known as a web-rotary press and generally used for large quantity printing in newspaper, magazine, and book work. There are two types, one for black-ink printing, the other for colour work. This press is basically a series of synchronized rotary presses which are automatically fed by one or more rolls of paper at a time. The web-rotary press does the complete job of printing: it prints on both sides of the paper; cuts, assembles and folds the pages; counts the number of copies printed. For full production, the web-rotary press requires a crew of five or more workers.

Specially designed rotary presses, calling for different techniques, are used in offset and gravure printing.

Bindery Occupations

Many printed products, such as newspapers, business forms, labels, etc., require no further work after they leave the press. Books, magazines, pamphlets and folders, however, are put into final form by bindery workers. Many of the bindery jobs are done by women. Such jobs are folding, gathering sheets or collating sections to form books, operating punching and stitching machines, and hand sewing. Jobs such as hand bookbinding, book finishing, embossing, and operating the more complicated types of machines are usually done by journeymen.

According to the United States *Dictionary of Occupational Titles,* the skilled bookbinder "performs any or all operations entailed in affixing covers to sewed-together signatures to form books or pamphlets, and in finishing books or pamphlets: Creases folds of sewed-together signatures of unbound books and compresses books to size. Applies glue to back of sewed signatures to stiffen

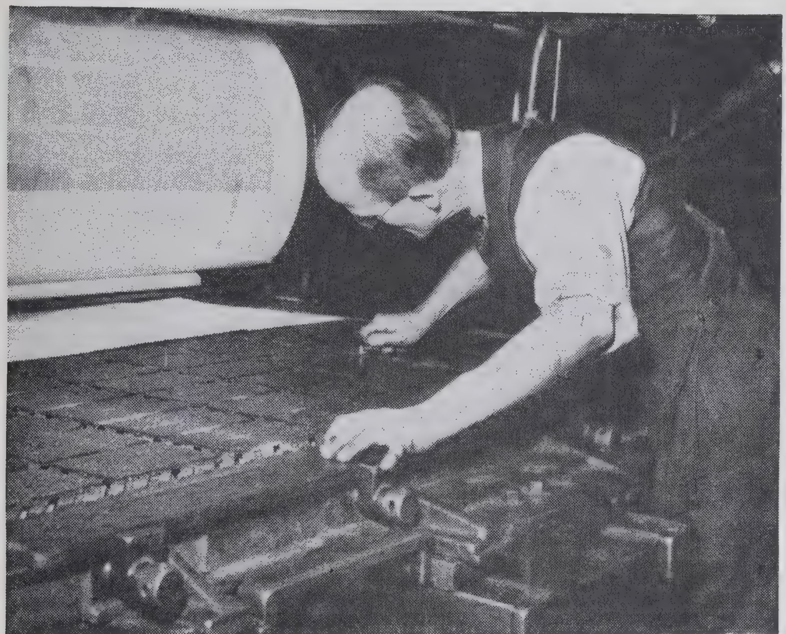

Photo: N.F.B.

Trueing up plates on the press

back of book body, and forms joint of book covers and book bodies. Colours edges of signatures with plain colours or with mixed colours that give appearance of marble. Reinforces backs of books by gluing fabric strips to them. Glues cover boards to end sheets and dries books in press. May tool designs on book covers. May repair books."

QUALIFICATIONS

Entry into the printing trades is almost wholly through apprenticeship. The age at which apprentices are accepted ranges from 16 to about 30. The Apprenticeship Commission in Montreal limits the maximum entry age to 20, with exceptions.

Most of the printing trades call for good eyesight, about average physical strength, and a high degree of manual dexterity.

Colour-blindness is a serious handicap in the pressroom, as is left-handedness in the composing room. Some printing trades can be undertaken by those with certain physical handicaps. Workers with speech or hearing defects, or both, have found employment as hand and machine compositors and in most of the other printing trades. Some composing-room occupations are suitable for those who have suffered the loss of one or both legs, or who do not have the use of all their fingers. However, use of both hands is almost indispensable in all printing trades.

Speed with accuracy, mental alertness, neatness, patience, and the ability to work well with others are necessary. An artistic sense is an asset for many kinds of printing work. Perseverance is an essential quality, in view of the long apprenticeship period.

Printing workers, especially compositors and proofreaders, should have a fairly good general education, which includes a good grounding in the English or French language, or both, as the case may be. A high school education is preferred. The usual standard of education stipulated for apprentices is at least two years' high school or its equivalent.

Applicants who have completed a technical or trade school course in a printing trade are more likely to be accepted for apprenticeship than those who are untrained. Technical schools in the larger centres in Canada and the bilingual l'Ecole des Arts Graphiques, Montreal, offer industrial courses in printing that provide a very useful preparation for apprenticeship. An allowance is usually made for such training and the apprenticeship period correspondingly shortened.

Courses in art, such as drawing, design, colour and lettering, can be very helpful for many kinds of printing work.

TRAINING

The provinces of New Brunswick and British Columbia designate the printing trades for apprenticeship. The Apprenticeship Commission of the printing industry of the Montreal area, which represents both employers and unions, controls apprenticeship for that area.

Training programs in union shops are regulated by unions, in agreement with employers, and vary considerably according to

craft and locality. In general, the apprenticeship period lasts from four to six years, depending on the trade. The following summary shows the approximate length of time required for union apprenticeship in the various printing trades:

Compositors (all types)	5 to 6 years
Electrotypers	5 to 6 years
Stereotypers	5 to 6 years
Photo-engravers	
Photographer	5 to 6 years
Stripper and Printer	5 to 6 years
Zinc Etcher	5 to 6 years
Copper Etcher	5 to 6 years
Router and Blocker	5 to 6 years
Finisher	5 to 6 years
Proofer	5 to 6 years
Tint-Layer	5 to 6 years
Lithographers	
Process Artist	4 to 5 years
Stripper and Layout Man	4 to 5 years
Lithographic Proofer	4 to 5 years
Photographer	4 to 5 years
Platemaker	4 to 5 years
Hand Transferrer	4 to 5 years
Lithographic Pressman[1]	4 years
Opaquer and Tuscher	2 years
Stone and Plate Preparer	2 years
Press Assistant	2 years
Pressroom Occupations (Letterpress and Gravure)	
Newspaper Pressman	5 to 6 years
Commercial Pressman	5 to 6 years
Pressman Assistant[2]	2 years (minimum)

[1] The four-years' apprenticeship period is additional to the two years required to become a press assistant.

[2] This classification applies only to job shops. An apprentice must serve a period of at least two years before he can qualify as a press assistant. He then has the opportunity of registering as an apprentice pressman and, as such, is required to complete a special apprenticeship course of instruction and an additional two years of intensive training before he obtains his journeyman pressman's status. In the operation of newspaper presses there are only two classifications recognized — newspaper pressman and newspaper apprentice.

Bindery Occupations	
Bookbinder (Male)	4 to 6 years
Bookbinder (Female)	2 to 3 years

Training programs for apprentices are also conducted by employers of non-union and company-union shops.

Apprenticeship training usually includes, in addition to practical work on the job, classroom and correspondence work in related technical and other subjects. In areas where school facilities are not available, the greater part of the training is usually taken in the printing plant. In the Montreal area, in-plant training is complemented by technical instruction given at l'École des Arts Graphiques in Montreal.

Because of the continual changes that take place in printing methods and processes, journeymen frequently take further courses to bring themselves up to date. Such training is of particular value to those who wish to become specialists, foremen, supervisors or salesmen.

ENTERING THE OCCUPATION

The ratio of apprentices to journeymen is quite rigidly controlled in the printing trades. It is, therefore, advisable for the would-be apprentice to get in touch with the appropriate union local and the owners of printing establishments. In this way, he can learn not only what the possibilities for apprenticeship are, but also the specific requirements. The National Employment Service local offices can help an applicant make these contacts.

EARNINGS AND OTHER CONDITIONS OF WORK

Between 1949 and 1954, average wage rates increased nearly 50 per cent in the newspaper industry and nearly 40 per cent in job printing.

Working conditions in the printing, publishing and allied industries were surveyed by the Department of Labour in April 1955. Returns from 454 establishments employing a total of 28,000 non-office workers show that

— more than 90 per cent of the workers covered were on a 5-day week;

— nearly 90 per cent worked 40 hours a week or less;

— slightly more than 70 per cent were in establishments granting two weeks' vacation after a year's employment;

— almost 30 per cent were in establishments granting three weeks' vacation after 15 years' employment;

— more than 90 per cent received time and one-half for overtime and 80 per cent received double time or more for work on statutory holidays;

— 85 per cent were in establishments granting 8 or more paid statutory holidays;

— wage differentials for second and third-shift work were generally paid to tradesmen; in a number of cases the shifts were an hour shorter at night but the total daily pay was the same.

Average hourly wage rates for certain trades in the daily newspaper and job printing industries as at October 1955 are shown in the following tables. Current average wage rates would be higher than shown here because of new collective bargaining agreements made since then.

AVERAGE HOURLY RATES IN THE DAILY NEWSPAPER INDUSTRY, OCTOBER 1955

Locality	Standard Hours per Week	Average Wage Rate per Hour (time work)	
		Compositor, Hand and Linotype Operator	Pressman
		$	$
Newfoundland			
St. John's	44	1.46	1.46
Nova Scotia			
Halifax	37½	2.11	1.97
New Brunswick			
Saint John	40	1.78	1.78
Quebec			
Montreal	37-40	2.67	2.57
Quebec	40	1.82	1.80
Trois-Rivières	40	1.80	1.85
Ontario			
Hamilton	40	2.28	2.28
London	40	2.18	2.18
Ottawa	37½	2.61	2.61
Toronto	37½	2.91	2.91
Windsor	37½	2.53	2.53
Manitoba			
Winnipeg	40	1.94	1.89
Saskatchewan			
Regina	44	1.73	1.78
Saskatoon	40	1.90	1.90
Alberta			
Calgary	37½	1.92	1.92
Edmonton	37½	1.90	1.90
British Columbia			
Vancouver	37½	2.49	2.49
Victoria	37½	2.45	2.45

Source: Department of Labour, Annual Report on *Wage Rates and Hours of Labour in Canada,* October 1955.

AVERAGE HOURLY WAGE RATES IN THE JOB PRINTING AND PUBLISHING INDUSTRY, OCTOBER 1955

Locality	Standard Hours per Week	Wage Rate per Hour (time work) — Compositor, Hand — Average	Compositor, Hand — Predominant Range	Linotype Operator — Average	Linotype Operator — Predominant Range	Pressman, Cylinder — Average	Pressman, Cylinder — Predominant Range	Pressman, Platen — Average	Pressman, Platen — Predominant Range	Pressman, Offset — Average	Pressman, Offset — Predominant Range	Bindery Worker, Hand, (Female) — Average	Bindery Worker, Hand, (Female) — Predominant Range
		$	$	$	$	$	$	$	$	$	$	$	$
Newfoundland — St. John's	44–45	1.32	....	....	....	1.31	....	....	....	....	....	.52	.40– .66
Nova Scotia — Halifax	40–42	1.33	1.10–1.60	1.53	....	1.18	1.05–1.32	1.11	.80–1.35	....	....	.60	.50– .70
New Brunswick — Saint John	40	1.54	....	....	....	1.54	....	....	....	....	....	....	....
Quebec —													
Montreal	40–45	2.11	1.94–2.25	2.11	1.98–2.37	2.05	1.85–2.20	1.81	1.60–1.94	2.35	1.95–2.80	1.01	.93–1.03
Quebec	40	1.67	1.65–1.68	1.67	1.65–1.72	1.65	1.63–1.68	....	....	....	....	.84	.78– .90
Ontario —													
Hamilton	40–42½	2.07	2.05–2.15	....	....	2.05	1.97–2.10	1.85	1.50–2.10	2.47	2.15–2.70	.98	.80–1.11
London	40–44	1.85	1.57–1.97	1.89	....	1.91	1.87–1.95	1.77	1.55–1.89	2.45	2.01–2.71	.84	.75– .90
Ottawa	40–43	1.93	1.60–2.07	1.99	1.95–2.03	1.96	1.85–2.07	1.60	1.25–2.00	2.02	1.65–2.25	.92	.70–1.05
Toronto	40–45¼	2.22	2.19–2.34	2.22	2.19–2.29	2.09	2.00–2.19	2.05	1.84–2.18	2.42	2.06–2.91	1.05	.85–1.15
Windsor	40	2.10	....	....	....	2.10	1.75–2.25	2.00	....	....	....	1.19	1.05–1.25
Manitoba — Winnipeg	40–44	1.91	1.90–2.00	1.92	1.87–2.03	1.85	1.77–1.97	1.82	1.75–1.97	2.01	1.79–2.34	.93	.75–1.00
Saskatchewan — Regina	40	2.01	1.90–2.18	1.99	1.90–2.00	2.00	1.75–2.10	1.96	1.87–2.08	....	....	1.11	....
Alberta —													
Calgary	40	1.90	1.87–1.95	1.96	1.87–2.02	1.91	1.87–1.95	1.92	1.87–2.08	1.97	1.87–2.02	1.03	.88–1.09
Edmonton	40	1.93	1.90–2.00	1.96	1.90–2.05	1.94	1.90–1.95	1.92	1.90–2.00	2.00	1.90–2.15	1.09	1.06–1.16
British Columbia—													
Vancouver	40	2.26	2.09–2.31	2.30	2.09–2.41	2.21	2.09–2.26	1.98	1.65–2.26	2.35	1.94–2.81	1.30	1.20–1.39
Victoria	44	2.26	....	2.28	2.26–2.33	2.26	....	....	....	....	....	....	....

Source: Department of Labour, Annual Report on *Wage Rates and Hours of Labour in Canada*, October 1955.

Wage rates for apprentices are based on a percentage of those current for journeymen. They will, therefore, vary according to locality. Apprentices receive graduated increases, in some cases every six months, in others every year, throughout the period of apprenticeship until the maximum is reached.

ADVANCEMENT

The usual ladder of advancement is apprentice to journeyman to foreman to plant superintendent.

Although the tendency is for tradesmen to remain in the trade for which they are trained, men in the composing room, with a creative flair, may become designers and layout men in the advertising field. The man who has leadership ability and who has a thorough knowledge of his department may advance to foreman. A foreman possessing supervisory and managerial qualities, who is well versed in the mechanics of the presses used in all departments, is acquainted with engraving processes, and has some knowledge of pricing policies and other pertinent details, may become a plant superintendent.

Firms, such as printing machinery houses, paper companies, and ink manufacturers, sometimes prefer to employ skilled craftsmen as salesmen, or perhaps as technical men, since they are better able to cope with the problems of customers.

A good number of tradesmen have assumed the management of smaller newspapers or become proprietors of small job-printing shops.

ADVANTAGES AND DISADVANTAGES

The printings trades are, in general, strongly organized, which benefits the workers not only in terms of wages and paid vacations, but also in security of tenure. The major printing unions are known for welfare provisions which include pensions, hospitalization and educational programs.

With some exceptions, the printing trades offer interesting work, especially in the skilled occupations. The steady development of new methods and processes adds interest to the work, and encourages further study.

Generally speaking, employment is steady and the standards of pay are good. The printing trades are affected only moderately by seasonal fluctuations and are not as hard hit as many other trades in times of economic depression. There are a variety of highly skilled jobs that a worker can enter, given the opportunity, after reaching journeyman standing.

Another advantage of the printing trades is that, generally speaking, they are insurable occupations and are eligible for unemployment insurance benefits.

Much of the work is exacting and tedious in nature, and would tend to be irritating to one who lacks patience or is nervous in temperament. Certain jobs, such as press feeding, proofreading and bindery work can be very monotonous.

Often the worker is under pressure to meet a time limit. In the newspaper and magazine field, night work may be involved, but there is usually the incentive of higher wage rates or other compensation for such workers.

Working conditions are good on the whole, but the composing and pressrooms are unavoidably noisy. The usual occupational hazards associated with machines exist for bindery, press and other workers, and there is a slight risk of lead poisoning for machine compositors. These dangers can, however, be avoided with proper care. The accident rate is comparatively low.

LABOUR ORGANIZATIONS

The printing trades are highly organized in Canada, especially in urban areas. As a result, wages, working conditions and hiring policies are strongly influenced by unions. The closed-shop type of agreement is quite common, but some printing establishments are open shops or, in some cases, are covered by a company union.

There are several international unions of printing workers in Canada. These are organized by individual crafts; the different trades in lithography, however, are organized in the one union. The situation is slightly different in Quebec where the workers are organized either by the international unions or by a national union that covers all the printing trades.

The reader is referred to the publication *Labour Organization in Canada* prepared by the Department of Labour, Canada, for a listing of the national and international printing trade unions and the number and location of their branches.

TRENDS

Growth

Employment in the printing and graphic arts industry has increased markedly in the last few years. Data compiled by the Dominion Bureau of Statistics; on the basis of establishments employing 15 or more workers, show that between 1939 and 1954 (the latest date for which statistics are available) employment in the industry rose by nearly 68 per cent to a total of 63,200. Throughout the entire period the employment trend was broadly upward. During the early forties, however, the war resulted in a lack of replacements and new entrants and the labour force decreased slightly. The graphic arts industry had suffered unemployment during the depression in the thirties but it recovered quickly and since then has had less unemployment, on the whole, that most industries in manufacturing. Since the end of the war, employment in the industry has kept pace with the upward surge in activity that has characterized the Canadian economy as a whole.

The above figures cover all categories of workers in the printing industry but the number of skilled and semi-skilled tradesmen in the industry has also grown considerably. Comparison of census figures for 1931, 1941 and 1951 bears this out, as the following table indicates:

SKILLED AND SEMI-SKILLED WORKERS IN THE PRINTING, PUBLISHING AND BOOKBINDING INDUSTRY

	1931	1941	1951	Percentage Change 1941-1951
All tradesmen	22,773	23,324	32,978	+ 41
Male	19,721	20,062	27,010	+ 35
Female	3,052	3,262	5,968	+ 83
Engravers, lithographers and photo-engravers	1,759	2,007	3,523	+ 76
Male	1,756	1,946	3,345	+ 72
Female	3	61	178	+192
Printers(1)	—	17,232	20,841	+ 21
Male	—	16,399	19,661	+ 20
Female	—	833	1,180	+ 42

(1) Includes compositors, typesetters, pressmen and plate printers.
Source: 1951 Census.

As the preceding table shows, printers are the largest group of tradesmen in the industry; in 1951, they made up 63 per cent. The number of engravers and lithographers has, however, increased markedly since 1941, reflecting the growing use of engraving and lithographing processes. This trend is likely to continue. Bookbinders, on the other hand, (not shown separately in the table) are not increasing as rapidly as other trades. In 1951, less than 10 per cent of the tradesmen in the industry were in this group.

Although the number of women employed as either printers or lithographers is relatively small, it is interesting to note that the percentage increase between 1941 and 1951 has been substantial, both in these occupations and for the skilled and semi-skilled occupations as a whole.

Geographic Distribution

The heavy concentration of printing employees in the central provinces is evident from the following table. More than three-quarters of the gainfully occupied were employed in Quebec and Ontario in 1954, employment in Ontario being double that of Quebec.

DISTRIBUTION BY PROVINCE OF EMPLOYEES IN THE PRINTING TRADES INDUSTRY, 1954

	Male	Female	Total	Per Cent Distribution
Canada	46,823	16,365	63,188	100.0
Nfld.	306	84	390	0.6
P.E.I.	115	34	149	0.2
N.S.	881	306	1,187	1.9
N.B.	670	230	900	1.4
Que.	12,333	3,638	15,971	25.3
Ont.	23,559	9,212	32,771	51.9
Man.	2,693	958	3,651	5.8
Sask.	1,131	362	1,457	2.3
Alta.	1,626	512	2,138	3.4
B.C. and Yukon	3,509	1,065	4,574	7.2

Source: Dominion Bureau of Statistics, *The Printing Trades,* 1954.

The regional distribution of the various printing trades shows the same pronounced concentration of tradesmen in the central provinces.

PERCENTAGE DISTRIBUTION OF PRINTING TRADESMEN BY REGION, 1951

	Maritimes	Quebec	Ontario	Prairie Provs.	B.C.	Total No. in Canada
Bookbinders	3.4	33.6	47.9	8.6	6.5	3,219
Compositors & typesetters	5.5	28.3	45.9	12.4	7.9	15,253
Photo-engravers & lithographers ..	1.6	25.0	60.0	5.7	7.7	2,594
Pressmen & plate printers	3.2	28.3	52.8	9.6	6.1	5,588
Other bookbinding occupations ...	2.0	24.3	52.4	15.3	6.0	1,587
Other printing & publishing occupations ...	2.5	25.5	59.1	8.2	4.7	2,125

Source: 1951 Census.

As is to be expected, most printing tradesmen are in the larger urban centres. The two cities of Toronto and Montreal bulk large in this employment picture. Together they employ 27 per cent of all compositors and typesetters, 39 per cent of all bookbinders, 38 per cent of all photo-engravers and lithographers, and 34 per cent of all pressmen and plate printers.

PERCENTAGE DISTRIBUTION OF PRINTING TRADESMEN, BY SELECTED CITIES, 1951

	Montreal	Toronto	Van-couver	Winnipeg	15 Metro-politan Centres
Bookbinders	18.0	20.8	3.2	3.1	61.1
Compositors & typesetters	13.9	13.6	3.7	3.4	49.4
Photo-engravers & lithographers	15.0	22.6	5.1	2.2	59.4
Pressmen & plate printers	15.3	18.7	3.8	3.8	53.7
Other bookbinding occupations	12.4	16.1	3.6	2.5	61.2
Other printing & publishing occupations	14.8	20.8	2.6	3.5	58.8

Source: 1951 Census.

Industrial Distribution

Most printing workers are employed in the printing and publishing industry but some are to be found in a number of other

industries, such as paper products manufacturing, textiles, and trade and service industries, as well as in government service.

PERCENTAGE DISTRIBUTION OF PRINTING TRADESMEN, BY SELECTED INDUSTRIES, 1951

	Printing & Publishing	Paper Products Mfg.	Trade	Service Gov't	Service Other
Compositors & typesetters	88.7	2.6	1.7	1.9	1.6
Photo-engravers & lithographers ..	84.2	2.5	2.2	2.0	0.8
Pressmen & plate printers	84.9	6.3	2.3	1.3	nil
Bookbinders......	85.2	nil	3.1	2.5	4.1

Source: 1951 Census.

Age Distribution

An examination of the distribution of printing tradesmen by age in 1951 shows that male bookbinders had a larger proportion (19.5 per cent) in the 55-and-over age group than the other printing trade groups. Compositors and typesetters came next with 13.8 per cent.

AGE DISTRIBUTION OF PRINTING TRADESMEN, 1951
(Percentages)

	Under 45	45-54	55+
Bookbinders			
Male	68.3	12.2	19.5
Female	79.5	12.5	8.0
Compositors & typesetters			
Male	72.6	13.6	13.8
Female	74.3	18.0	7.7
Photo-engravers & lithographers			
Male	78.5	10.9	10.6
Female	85.2	9.5	5.3
Pressmen & plate printers			
Male	74.6	14.6	10.8
Female	87.3	8.7	4.0

Source: 1951 Census.

Employment Prospects

The long-term trend in the employment of most printing tradesmen has been steadily upward and it is likely that this trend will continue for some time to come.

Mention has been made of the high proportion of tradesmen in the central provinces and in the larger cities. Because of this, openings should be more plentiful and of greater variety in these areas than elsewhere, particularly for photo-engravers, lithographers and bookbinders. The concentration of compositors and typesetters in the larger cities is not as marked, and many small-town printing shops that publish weeklies and do job work offer these tradesmen opportunities for employment. It can be expected, of course, that competition for jobs in the printing trades will be keenest in the large cities.

The majority of printing tradeswomen are employed in bookbinding occupations; relatively few in the other trades.

Approximately two-thirds of all printing tradesmen are to be found in the printers' group of occupations (compositors and pressmen). The likelihood is that the greatest number of opportunities will be in machine composing and press work. Monotype keyboard operation, monotype casting, electrotyping and stereotyping are expanding fields, but the number of openings that may occur here will be considerably fewer than for linotype operators and pressmen.

Expansion should also occur in the photo-engraving and lithographic fields. There is a shortage of photo-engravers at the present time, owing to the growing use of rotogravure and colour in newspapers and in the food packaging field. Similarly, the increasing use of illustrations and colour should benefit the lithographic trades and provide a greater demand for lithographers, pressmen, and other tradesmen skilled in colour work.

One of the biggest developments of recent years has been the remarkable growth of black and white offset printing. This kind of printing is now in keen competition with the regular letterpress on many types of work. It also appears probable that offset work will increase, which will mean a demand for more workers trained in offset methods.

Bookbinding has, in the process of mechanization, become an occupation needing a smaller proportion of fully skilled workers. The trade is dependent upon the demand for books and is directly affected by economic conditions. The long-term trend for all-round bookbinders will probably continue downward.

Seasonal unemployment is not very common in the printing trades, the number of workers employed throughout the year being quite constant. Adverse economic conditions affect certain types of printing more than others, less so in the newspaper field and more so in the job printing field. A high level of business makes for a high demand for printed products and advertising materials; consequently, printing tradesmen who are employed in establishments dependent on this demand are more affected by a low business level.

Technological Changes

Some consideration must be given to the probable effects of technological changes on opportunities for printing tradesmen. The introduction of the composing machine has resulted in fewer jobs for hand compositors. Advances in presses have changed the character of the pressmen's work. There has been rapid improvement in the offset printing process, both in reproduction and in presses.

The demand for machine compositors in the newspaper field has been affected to some extent by the introduction of the teletypesetter. Most of the typesetting required by a newspaper is still, however, done by linotype and monotype operators. The teletypesetter can transmit copy to a number of newspapers in the form of perforated tape which, when fed through an attachment on a linotype machine, causes type to be set automatically. This machine is mainly used by newsgathering agencies, such as the Canadian Press, to service its member newspapers.

Most shops are using the printing methods and equipment previously described. In some shops, however, photo-typesetting machines and new makeup methods are supplanting conventional metal type methods. It is likely that these new machines will come into wider use as time goes on.

Where photo-typesetting machines are used, layout is done on a master form, indicating where borders, lines, illustrations, display type or other type material are to be placed. In paste makeup the workman places film or paper in position on the master form, as he would type or cuts in the metal type process. The completed master is checked, proofread, then photographed, and a printing plate made.

Some of the new photo-typesetting machines have the same function as the linotype, intertype and monotype machines — to produce type material by keyboard operation. Instead of casting metal slugs, however, these new machines have built-in cameras that produce type material set up line by line on a roll of photographic film, which is developed in the darkroom.

Most of the lines of large display type are composed on photo-lettering machines. The type material is in the form of strips which, depending on the type of machine used, may be developed in the darkroom or in the machine itself.

Although radically different from conventional metal type methods, the new processes still require a thorough understanding of the graphic arts. In shops where these changes are being made, journeymen are being trained in the new methods, as are apprentices after they have received basic training in the metal type methods.

Technological change has, in the past, gradually altered the character of the printing trades and will continue to do so in the future. The established trades, and those that have come into being recently, offer good opportunities in a steadily expanding printing industry, an industry which plays a vital role in the lives of Canadians.

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LOCAL INFORMATION

LOCAL INFORMATION

LOCAL INFORMATION

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(8) Machinist and Machine Operators (Metal)
(9) Printing Trades
(10) Motor Vehicle Mechanic
(11) Optometrist
(12) Social Worker
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(27) ——
(28) Chemical Engineer
(29) Civil Engineer
(30) Electrical Engineer
(31) Forest Engineer and Forest Scientist
(32) Mechanical Engineer
(33) Metallurgical Engineer
(34) Mining Engineer
(35) Petroleum Engineer

(36) Hospital Workers (other than Professional)
(37) Draughtsman
(38) Welder
(39) Careers in Home Economics
(40) Occupations in the Aircraft Manufacturing Industry
(41) Careers in Construction

Filmstrips

The Department of Labour has prepared, to date, the following occupational filmstrips in collaboration with the National Film Board. A manual has been prepared as an accompaniment to each filmstrip. These may be purchased from the National Film Board, Box 6100, Montreal, or from any one of its regional offices.

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DEPARTMENT OF LABOUR

Economics and Research Branch

CANADA, 1957

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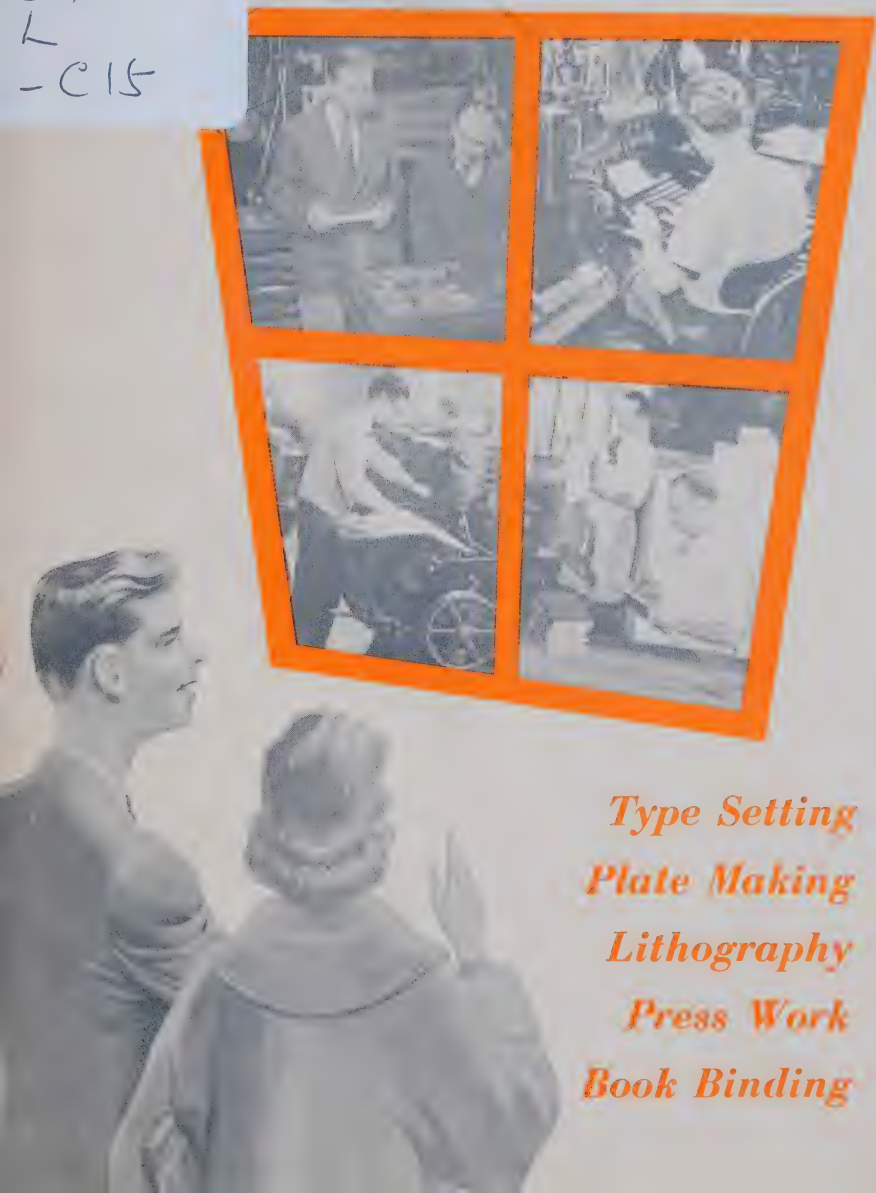
PRINTING TRADES



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Canadian Occupations
Monograph 9

PRINTING TRADES

Prepared
by the
Economics and Research Branch
of the
Department of Labour, Canada

First Published 1950
Revised 1957
Second Edition 1960

HON. MICHAEL STARR, MINISTER

FOREWORD

During recent years there has been a steadily increasing demand for Canadian occupational information. The demand comes from young people faced with the need of choosing an occupation and preparing for it; from parents, teachers and vocational guidance counsellors; from workers wishing to change their occupations; from employment service officers; from personnel directors and union officials; from prospective immigrants to Canada, and from other quarters.

The CANADIAN OCCUPATIONS series of monographs is designed to help meet this demand. Each booklet describes, among other things, the nature of the occupation or group of occupations, entrance and training requirements, working conditions and employment outlook.

The series has been prepared with the generous assistance of representatives of management, trade unions and professional associations. The co-operation of the Unemployment Insurance Commission, the Vocational Training Branch of the Department of Labour, and the Dominion Bureau of Statistics is gratefully acknowledged.

Occupational information tends to become dated as a result of change in economic conditions, in industrial technology and in wage and salary structure. Revision of outdated publications is a regular feature of the series.

This revised edition of *Printing Trades* was prepared for the Manpower Resources Division by Mary E. Stuart and William Allison, Chief of the Occupational Analysis Section.

W. R. DYMOND,
Director,
Economics and Research Branch,
Department of Labour.

December 1960.

CONTENTS

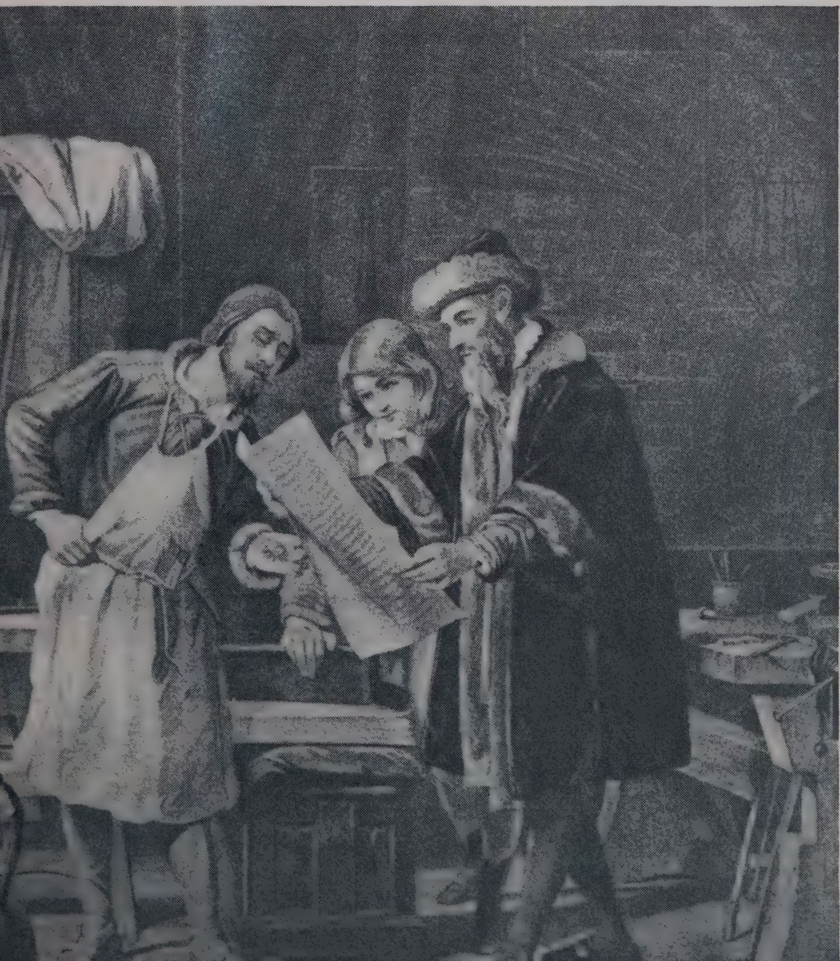
Gutenberg began printing the Mazarin Bible, the first book known to be printed using movable type, about 1450 and finished the work about 1455. He and his partner tried to hide from their competitors the fact that they were using a revolutionary method but the secret was soon out. By 1500 printing presses were in operation in more than 220 places in Europe.

(Photo: Bettmann Archives, New York)

PRINTING TRADES

HISTORY AND IMPORTANCE

The term "printing" is applied to the art of impressing letters, figures, etc., on paper or other substance. History records that the Chinese, as far back as 868 A.D., duplicated the written word by means of wooden blocks carved in relief. It was not until the fifteenth century, however, when Gutenberg in Germany invented movable type and the hand-operated printing-press, that the way was opened for the rapid growth of the printing art, and the extension of learning and culture to men everywhere.



Up to that time, Europe knew only the hand-written books of the skilled scribe — books that were scarce and expensive. In the printing-press a less expensive medium was found, which permitted a more rapid spread of information. Greek and Roman classics in printed form were soon in general use. Men's minds were stimulated and found expression in the enlightened thinking of the Renaissance.

Printing has rightly been called "the art which preserves all the arts" and the "Mother of Progress". It is difficult to think of any activity in which the printed word does not play a part. It is used not only for social, scientific and cultural purposes, but also for the conduct of government, business and industry. The expansion of free education to all classes during the past century created a greatly increased demand for printed matter.

The present status of the printing industry is largely the result of new machines and processes introduced in the nineteenth century. These, together with cheaper paper-making methods, so reduced printing costs that the demand for the printed product was greatly stimulated.

One can but briefly review here some of the important changes that took place in that century. The first paper machine making a continuous web of paper was successfully started in England in 1804. The high cost of paper made from rags hindered the natural growth of the industry for many years. After 1860, the production of paper from wood pulp had a striking effect on the availability of paper, especially newsprint, at reduced costs. Canada, through the development of its vast pulpwood resources, has played a major part in the supplying of newsprint to the printing industry the world over. More than forty nations, including the United States, depend on Canada for much of their newsprint.

Job presses were greatly improved in the second quarter of the nineteenth century; the first rotary press in America appeared in 1865; the linotype and monotype typesetting machines, in the 1880's. Stereotyping, photo-engraving and lithographing processes were also introduced in the nineteenth century, but modern lithography is a quite recent development.

These new machines and processes made for the growth of a highly skilled body of tradesmen who form the backbone of the printing industry.

There is a considerable variation in the size of printing plants and in the type of work they produce. There are job or commercial printing plants which range from the one or two-man shop to large establishments using batteries of typesetting machines and presses. This group includes plants capable of producing any type of printed matter. Some job shops specialize in one or more of such printing processes as lithography, photo-engraving, electrotyping and stereotyping. Also within this field are service shops (trade plants), which do specialized work for other printing plants.

In addition there are newspaper establishments, magazine and book publishing houses. The two former may also do job work.

The printing industry is also important from an economic standpoint. In 1958, the last year for which Canadian statistics are available[1], total production reached a value of almost $686 million. During the year, 2,877 establishments were in operation, employing about 66,300 workers. Salaries and wages paid out amounted to approximately $271 million.

It is intended in this monograph to deal mainly with the skilled and semi-skilled trades, which are learned through apprenticeship training. Approximately 65 per cent of the working force of the printing industry is made up of such tradesmen.

[1] Dominion Bureau of Statistics, *The Printing Trades*, 1958.

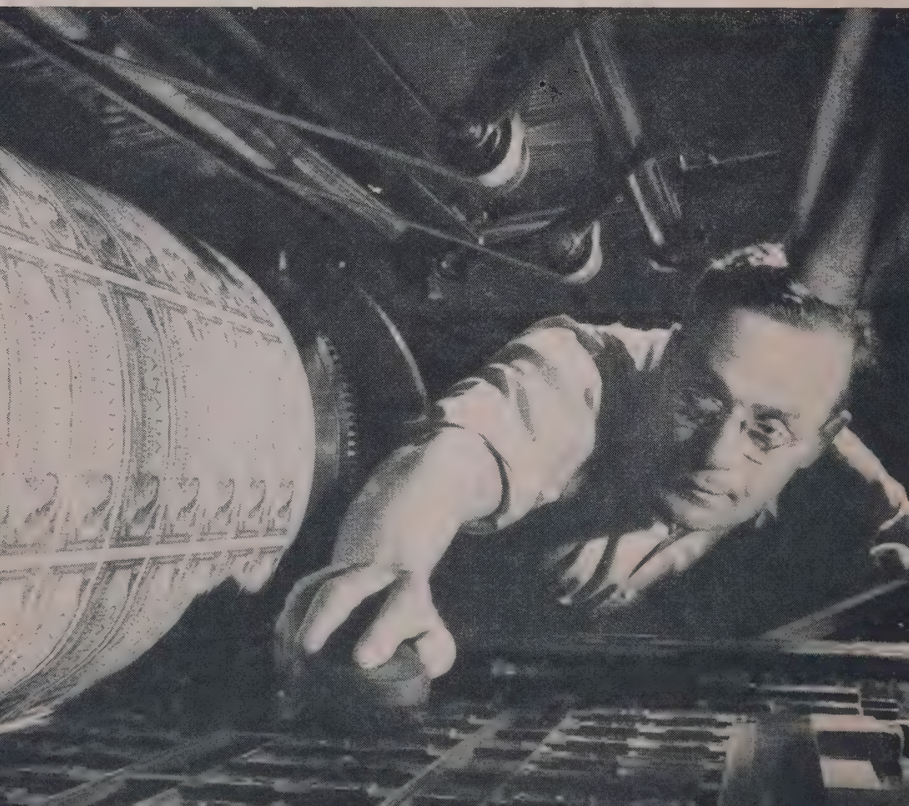
PRINTING METHODS AND PROCESSES

The printing process begins when copy, in the form of written text and photographs or drawings, is received from the author. Three principal methods of reproduction are *letterpress*, *lithography* and *gravure*.

Letterpress, (known as relief printing because the printing surface which receives the ink is raised above the rest of the type) is the oldest and most common form of printing. It is in the letterpress method that we find the traditional printing trades.

In lithography the press plate is smooth, as both the printing and non-printing areas are on the same level. Using the principle that water and grease repel each other, the printing area is coated with a greasy substance and the plate is moistened with water. When ink is applied it is absorbed by the greasy printing surface

ne printing of money requires the greatest of care and attention to detail. ere a pressman is seen cleaning the engraved signatures of J. E. Coyne d J. R. Beattie. This press prints 360,000 bank notes per day. (Photo: N



but is repelled by the water. In printing, the image is transferred to an intermediate rubber roller and then offset to paper.

In gravure printing, the printing area is etched below the surface of the plate. The whole plate is inked, then wiped, leaving ink in the depressions only. The suction that is created when paper and plate come together draws the ink out from the depressions onto the paper. This method gives finer reproduction than either letterpress or lithography and the plates stand up better than letterpress on long runs. On shorter runs, lithography has certain advantages over gravure.

The etching for gravure may be done by hand or machine, or it may be done by photography (*photogravure*). Examples of printing by hand or machine-engraved plates are engraved stationery and greeting cards, and printed metal foil. A common form of photogravure are newspaper picture supplements, known as *rotogravure* because the engraving is done on cylindrical copper plates.

A fourth and less well-known form of printing is the *silk-screen* process. This is a form of stencilling that has been developed for the printing of textiles, glass, posters and other items where there are large areas of colour, particularly when fluorescent inks are used. The stencil is mounted on a fine-mesh silk or metal screen and the colour is forced through, giving a facsimile of the original design.

Stencil cutting, plate making and photography, the skilled operations in the process, are done by craftsmen trained on the job in their particular specialty. Other silk screen operations can be learned in a few weeks of on-the-job training.

NATURE OF THE WORK

Any printing establishment is concerned essentially with four things: type setting, plate making, press work and book binding. Within these four areas there are a large number of occupations which vary from highly skilled to unskilled.

In small plants one or two men may carry out all the duties involved in composing, printing, and binding, but in the large plants each of these functions is carried out by special departments, and within each department the work is broken down into a number of specialized operations.

The following is a brief outline of the main skilled and semi-skilled trades that may be found in a printing establishment.

Type Setting

The term *compositor*, *typesetter*, or *typographer* applies to anyone who sets type by hand or machine. Before the introduction of the linotype machine, all typesetting was done by hand. Today, however, the machine is to the fore, but hand composing still plays an important part. In some small shops all the type is still set by hand. Many shops use machines for "straight matter", and headlines, titles and other display type are set by hand or with the Ludlow machine. It is of primary importance that the apprentice learn hand typesetting before he proceeds to machine work.

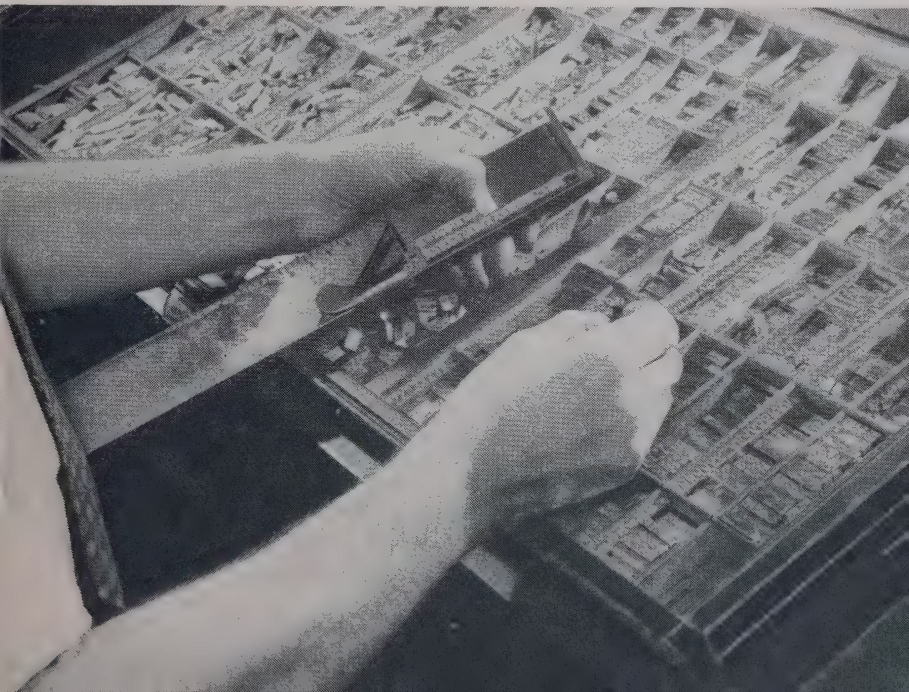
The *hand compositor* sets type by hand, letter by letter, with proper spacing, in a composing "stick". When the stick is full, the lines of type are transferred to a metal tray or "galley". Among other things, he may, especially in small shops, assemble machine and hand-set type, pull proofs of type-forms, proofread, correct typesetting errors, and do "make-up", that is, arrange type and engravings into pages.

The *linotypist* operates a machine that has a keyboard similar to that of a typewriter but with different arrangement and action. (The Intertype machine is similar to the linotype.) After he completes a line of type, the linotypist works a lever and the machine automatically casts the line of type in a solid strip of metal known as a "slug". Each slug is automatically trimmed, and placed in a galley. The linotype machine is used for newspaper, magazine, book and some job work.

The monotype machine differs from the linotype in that it casts each character separately instead of a line at a time; also the typesetting is done in two steps instead of one. The *monotype keyboard operator* operates a keyboard that punches holes in a paper ribbon. The ribbon is then put through a monotype casting machine by the *monotype caster operator.* This machine casts each character separately, according to the arrangement of holes. The advantages of the monotype machine are that it permits single letter corrections, and makes a better job of spacing letters and words. It also handles tabular matter more efficiently, especially where vertical ruling is required. In the linotype, corrections must be made by entire lines. The latter machine, however, gives a greater rate of production. The monotype machine is used mostly for book and periodical work and for some commercial printing.

The *Ludlow operator* combines hand and machine work. Individual letters or words are set by hand and the Ludlow machine casts them into slugs.

ach font (a complete set of one size of type) consists of 137 characters, cluding upper and lower case letters, numbers, punctuation, etc. Com-ositors use a variety of fonts when preparing material, selecting characters om trays and fitting them in the composing stick to form lines. (Photo:

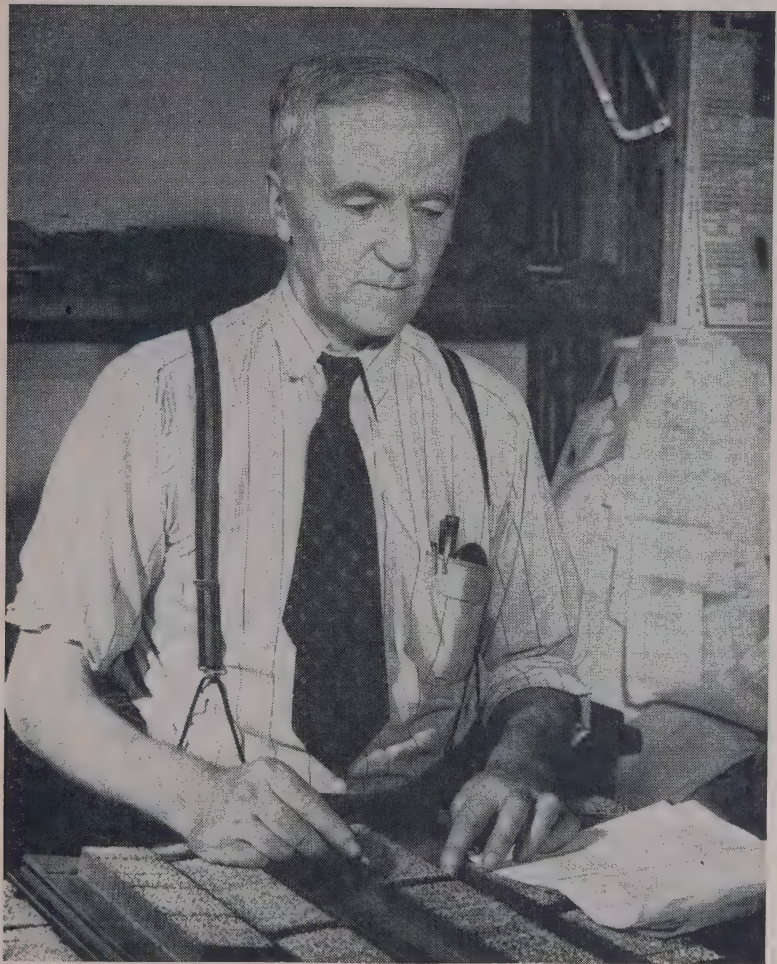


As the linotype operator presses the keys, individual letter moulds that form the type are collected in a line. When a line is completed, it is automatically positioned to receive molten lead. The lead quickly hardens and the completed line or "slug" is ejected into a receiving galley.

(Photo: NFB)

The stoneman prepares type for the press, making sure that everything is in position and that type is standing erect and level in the "chase".

(Photo: NFB)



(Photo: NFB)

The compositor receives proofs from the proofreaders and makes necessary corrections, revisions and additions in the standing type. When all is in order, he arranges type and illustrations into pages ready for the stoneman.

When all the typesetting is completed and has been placed and arranged in galleys by the *bankman*, proofs are pulled and are checked by *proofreaders* against the original copy for typographical, grammatical or compositional errors. *Copyholders* assist the proofreaders. In small shops, journeymen typesetters and advanced apprentices may do the proofreading. (Galley proofs are also commonly submitted to authors, editors or others responsible for the preparation of copy, before the final make-up of pages takes place.)

After corrections have been made by the compositors, the galleys of type are divided into desired lengths and, together with photo-engraved illustrations, page numbers, etc., are placed on a large, smooth steeltop table, known as a "stone", where they are arranged into pages by the *make-up man*. The *stoneman* then levels the type and locks the completed form in a chase (a steel rectangular frame). A final check is made by the *line-up* and *lock-up man*, who relocks the form in the chase (so that it will lift without spilling any type), after making certain that all type stands firmly upright and level and the margins are correct. The forms are then ready for the press, or for electrotyping or stereotyping.

Journeymen in the composing room, whether "all-round men" or "specialists", are usually trained in all its activities. There is thus a high degree of transferability among jobs in the composing room, especially in small shops.

Plate Making

Photo-engraving, *electrotyping* and *stereotyping* are complementary to letterpress printing. In photo-engraving, plates are made of copy that cannot be set up in type, such as illustrations. A photographic negative is printed on a copper or zinc plate that has been treated with a light-sensitive coating, and then etched with acid to make the illustration stand out in relief.

Stereotyping and electrotyping are used to make duplicate press plates of type-forms and photo-engravings. Stereotypes are used mainly in newspaper work; electrotypes, which are more durable, for books and magazines.

It may be asked why electrotyping or stereotyping is necessary when the original type-form is available. One reason is that type-forms are flat and cannot be curved to fit the cylindrical plate holders on rotary presses. Also, long runs of magazines, books or newspapers require several plates to preserve a clear print. Several presses may be used simultaneously to speed the work. It is simpler, faster and cheaper to duplicate type-forms by electrotype and stereotype than to use several original type-forms.

Photo-engraving

There are three different ways in which photo-engravings are made. *Line-etching* is cheap but it gives very little shading. The *half-tone* process gives finer detail and shading. In this process, copy to be reproduced is photographed through a fine cross-lined screen, resulting in a negative film on which the image is in the form of dots. The spacing and size of the dots determines the black, shaded or white portions of the picture (examine the various half-tone illustrations in this booklet). In both line-etching and half-tone the printing surface is raised as in letterpress printing. *Photogravure*, the third process, has the image etched below the surface.

Photo-engravers are mainly engaged in producing plates for letterpress printing, but are also employed in rotogravure work.

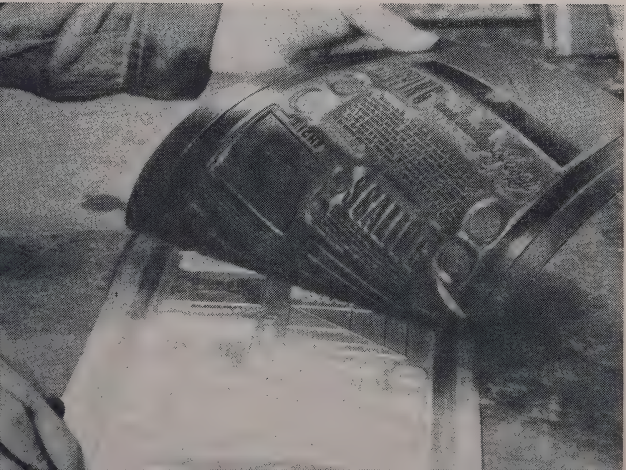
The skilled photo-engraver is capable of performing all of the operations involved in the process. In a large service shop, however, the whole job may be done by a number of photo-engravers, each specializing in certain operations, such as photography, printing, etching and finishing.

A photo-engraved plate is mounted on a block of wood to bring it to the required height for printing.

(Photo: Rapid Grip and Batten Ltd., Montreal)

This papier-mâché mat has come from a hydraulic press where it was under about 400 tons pressure. The stereotype moulder removes it from the type-form and checks it for imperfections.

(Photo: NFB)



An electrotype stripper removes the thin copper coating from the mould. The "shell" is then backed with lead to give it the required rigidity and thickness.

(Photo: Rapid Grip and Batten Ltd., Montreal)

In letterpress work, the photo-engraver may perform one or more of the tasks involved in reproducing photographs, drawings, paintings, and other illustrations in relief on zinc or copper plates: photographs illustrations to make line plate, half-tone, or colour half-tone; develops negatives and sets them in drying oven; strips negatives from photographic plates, places them in reverse position on piece of glass, and sets glass and negative over sensitized metal plate; exposes plate for several minutes; etches plate with acid so that the image stands out in relief; trims and mounts plate; corrects imperfections in the design; prints sample copies to check for errors.

The rotogravure photo-engraver performs work similar to the letterpress photo-engraver. In this case, the plate to which the image is transferred, instead of being flat, is a copper cylinder with a highly polished surface.

Stereotyping

In stereotyping, a mould is made by pressing a wet papier-mâché mat against the type-form. When the mould dries and hardens, molten type metal is poured into it, and the result is a metal casting which is a reproduction of the original type-form.

The main trades in stereotyping are:

Stereotype Moulder	— makes the impression of the type-form in the mat (consisting of flong or papier-mâché) by means of a press.
Mat Trimmer and Backer	— trims the edges of matrices (impressed mats) and reinforces backs of matrices so that they will not bend during the casting process; dries the matrices under steam pressure.
Stereotype Caster	— operates a machine that pours molten type metal into the mat.
Plate Finisher	— levels stereotype plates, smooths back of plate for mounting, bends plates to cylindrical form for use in rotary presses; routes both flat and circular plates for black and white and colour work.

Electrotyping

Duplication is achieved in electrotyping by using a wax or plastic composition, instead of a papier-mâché mould. After receiving the impression of the type-form, the mould is chemically treated. By the process of electrolysis, the mould is coated with a thin film of copper or nickel to form a duplicate of the original. The

copper or nickel impression is taken from the mould, backed with lead and mounted, ready for the press.

The main trades in electrotyping are:

Electrotype Mould Builder	— prepares wax and plastic composition moulds.
Electrotype Moulder	— impresses the type or photo-engraved plate forms in moulds.
Batteryman	— operates a plating bath to electroplate copper, lead or nickel on the graphite covered faces of lead, wax, or resinous moulds, to form reproductions, in plate form, of type set-ups for use in printing.
Electrotype Stripper	— removes shells (thin, electrically deposited coatings of copper or nickel) from moulds.
Plate Finisher	— trims and levels electrotype plates, smooths back of plate for mounting, bends plates to cylindrical form for use in rotary presses.
Electrotype Caster	— pours a backing of lead on electroplate shells to strengthen them for use in printing presses.

Lithography and Photo-offset

Up until the early 1900's, lithographic work was produced from drawings on stone (*lithos:* stone); since then metal plates have been adopted because they can be curved to fit the cylinders of modern lithographic rotary presses, permitting speedier reproductions. Some plates are still made by hand but in most cases they are made by transferring the desired image from a photographic negative to the light-sensitive metal plate, a process known as photolithography.

(Photos: NFB)

Illustrations and text matter prepared by the layout man is positioned in front of the camera and the photographer makes a negative.

Some of the principal occupations in lithography are:

Lithographic Artist — copies or creates designs on lithographic stones to be engraved by the "stone engraver", using soft, greasy crayons. In photolithography, he retouches negatives or positives by hand with chemicals and dyes. Corrects colours in final press plates.

Stone Engraver — cuts designs of type or illustration copy into the surface of lithographic stones, using hand and machine tools.

Photolithographer (Cameraman) — photographs in artificial light either illustration or typeset material to prepare a positive print (or a negative) for use in lithographic printing, enlarging or reducing print (or negative) to desired size. May use screen to break up shading of copy into dots for half-tone printing. May use colour filters to prepare various plates for colour printing.

Stripper and Layout Man — lays out the film or films on a large press-size glass plate or light opaque paper in order to obtain a final layout in accordance with the job specifications.

Plate Preparer or Grainer — prepares the faces of zinc or aluminum plates for use as lithographic printing plates by roughening (graining) with a machine which rotates steel or wooden marbles and wet pumice or sharp sand over the surface.

Transferrer (Press Platemaker) — transfers images by hand or machine from photographic negatives or positives to zinc plates for printing by the lithographic process. To effect a transfer by hand, the transferrer covers surface of grained zinc plate with a coating of photosensitive chemicals and allows plate to dry; the photographic negative or positive is placed on the plate and an exposure is made under strong artificial light, thus transferring the image from photograph to the plate. In the machine process, photograph and plate are placed in a vacuum frame or photocomposing machine and an exposure is then made.

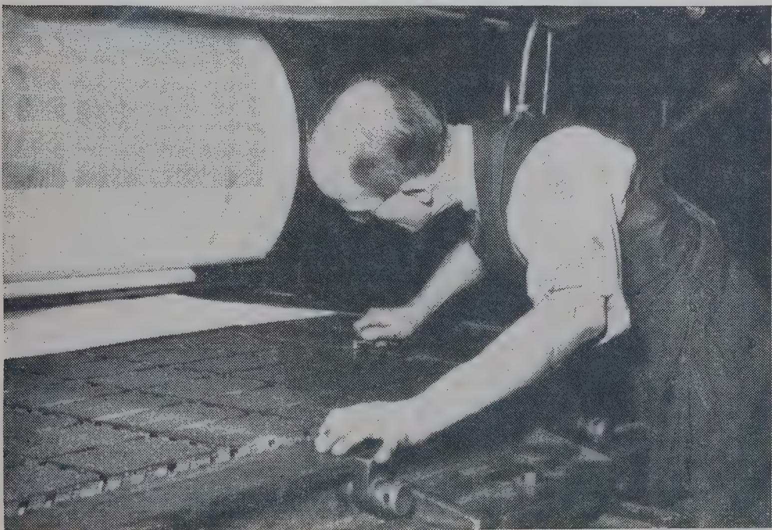
After the plate is developed, it is chemically treated, so that when moisture is applied to the press plate, the image areas will receive the greasy ink and the non-image areas will repel it.

Press Work

So far we have traced the work process in printing from the composing room, where the type was set, to the making of press plates by electrotyping, stereotyping, photo-engraving, rotogravure and lithographic processes. The next stage is the pressroom, where the actual printing is done.

The *pressman* operates a press or presses and is responsible for all work involved in printing. His duties include setting the forms or plates in place on the press, "making ready" (running a few samples through the press to ensure that the impression is even, and making final adjustments where necessary), seeing that the flow of ink is correct, and examining press sheets from time to time during the run. The pressman, who must be a journeyman, may be aided by *press assistants*, or other journeymen (in the case of large, automatic presses), who work under his direction.

There is a distinction between *press assistants* and *press feeders*. Many printing presses are now equipped with automatic feeders so that press feeders have been largely eliminated and replaced



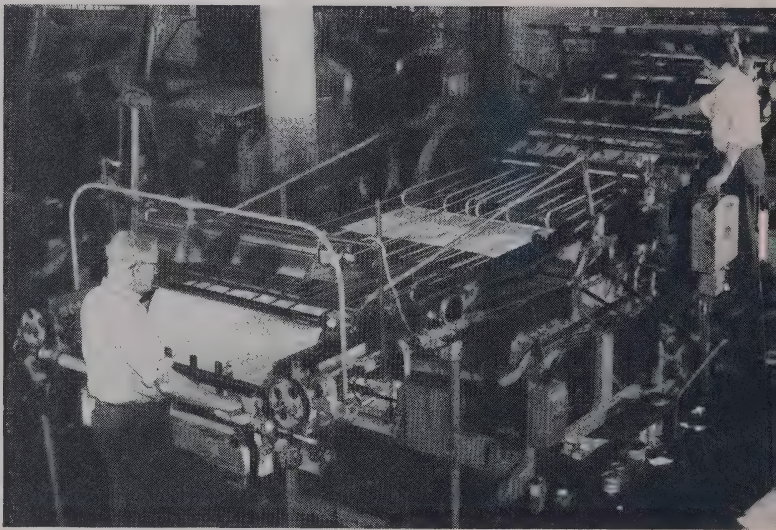
(Photo: NFB)

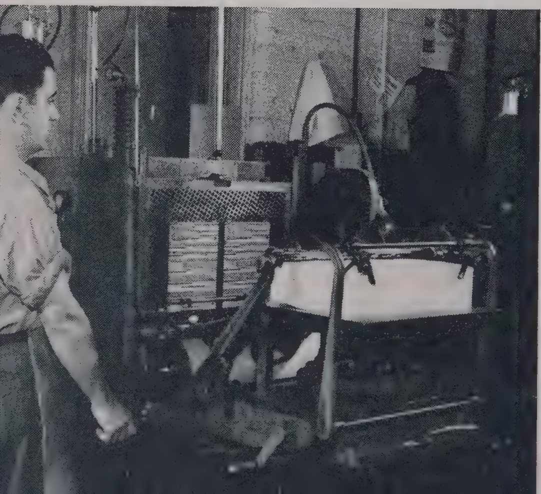
Pressmen and their assistants make regular checks of the printed material as it comes from the press. If anything goes wrong they stop the press, make adjustments, and run off a few copies to make sure everything is operating properly again.

PRESSES

Platen presses are used for job printing in short runs and for special jobs such as letterheads and handbills.

(Photo: NFB)





This automatic press does much the same work as a platen press and requires little attention once it is set up.

(Photo: NFB)

(Photo: NFB)

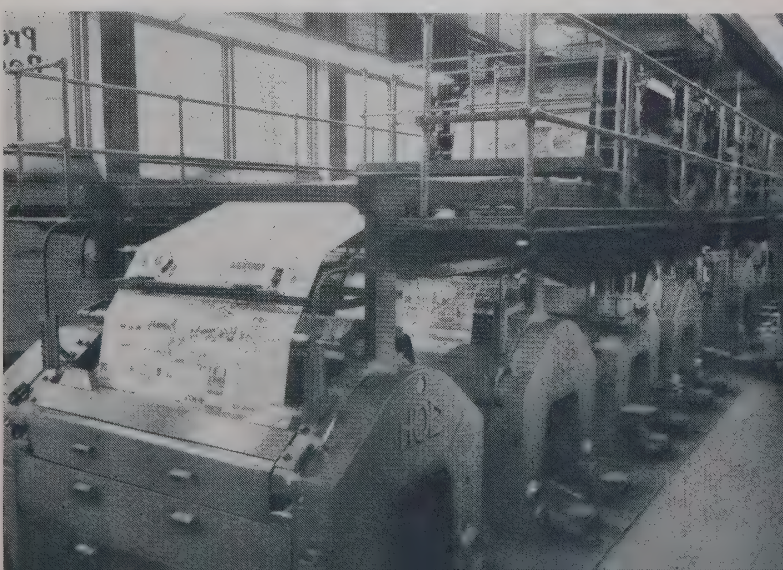
A lithographic offset press is good for very long runs and for reproducing fine art work, maps and catalogues in full colour. This particular press, at the Queen's Printer, Ottawa, is printing Hansard, the daily record of House of Commons and Senate debates.

Cylinder presses are used for printing books, as they can print many book pages on one large sheet of paper.

(Photo: NFB)

A six-unit high-speed rotary press can turn out over 46,000 48-page newspapers per day.

(Photo: Bill Lingard — Photo Features, Ottawa)



by press assistants. These workers are qualified to perform the duties involved in the care of equipment and accessories, loading automatic feeding devices, and assisting in preparing the make-ready. Press assistants may perform any or all of the duties of pressman, under the direction of a journeyman pressman.

Because of the variety of presses and the different methods of printing, the pressman's work varies. In small printing establishments, pressroom workers are usually required to operate more than one type of press and may also set up type by hand. In the larger commercial printing plants, press workers usually specialize in the operation of one kind of press. Some of the main types of press are as follows:[1]

Platen Press — consists of a frame supporting two flat surfaces —a vertical, stationary surface on which the type-form is locked, and a surface (called the platen) that moves from a horizontal to a vertical position in the printing process. The paper is placed upon the platen and is pressed against the type-form. Platen presses may be hand or automatically fed.

Cylinder Press — consists of a revolving cylinder, or drum, that carries the paper and is mounted above the flat bed of the press. The type-form is locked on the flat bed and is moved forwards and backwards with a shuttle motion underneath the cylinder. This press may be automatically or hand fed and may be a one or two-colour press.

Rotary Press (Sheet Fed) — consists of two revolving cylinders, mounted parallel to each other, one carrying the paper, the other the printing plate. The paper is fed either by hand or automatically.

Rotary Press (Roll Fed) — also known as a web-rotary press and generally used for large quantity printing in newspaper, magazine, and book work. There are two types, one for black-ink printing, the other for colour work. This press is basically a series of synchronized rotary presses which are automatically fed by one or more rolls of paper at a time. The web-rotary press does the complete job of printing: it prints on both sides of the paper; cuts, assembles and folds the pages; counts the number of copies printed. For full production, the web-rotary press requires a crew of five or more workers.

Specially designed rotary presses, calling for different techniques, are used in offset and gravure printing.

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[1] Description of presses adapted from *Pressroom Occupations* in the "Occupational Guide" series issued by the Michigan State Employment Service, Detroit, Michigan.

Book Binding

Many printed products, such as newspapers, business forms, labels, etc., require no further work after they leave the press. Books, magazines, pamphlets and folders, however, are put into final form by bindery workers. Many of the bindery jobs are done by women. Such jobs are folding, gathering sheets or collating sections to form books, operating punching and stitching machines, and hand sewing. Jobs such as hand bookbinding, book finishing, embossing, and operating the more complicated types of machines are usually done by journeymen.

Bookbinders perform all or several operations in affixing covers to sewed-together signatures. They fold and place the signatures in a hand press to reduce the size of the book, trim pages to size and round corners, apply glue to the backs of the signatures to stiffen the back of the book body, and shape them to receive the cover. In some cases, plain colours or a mixture of colours that give the appearance of marble are applied to the outside edges. Then the finished covers are glued to the end sheets and the completed books placed in a press to dry.

The bookbinder or a *book embosser* embosses the design or title on the book covers with hand tools, using gold, silver or colour.

Bookbinders are fitting the cover to the body of the book and checking for irregularities before sending it to the drying press. Much of the work is now done by machine.

(Photo: NFB)

PERSONAL QUALITIES NEEDED

Most of the printing trades call for good eyesight, about average physical strength, and a high degree of manual dexterity. Colour-blindness is a serious handicap in the pressroom, as is left-handedness in the composing room. Some printing trades can be undertaken by those with certain physical handicaps. Workers with speech or hearing defects, or both, have found employment as hand and machine compositors and in most of the other printing trades. Some composing-room occupations are suitable for those who have suffered the loss of one or both legs, or who do not have the use of all their fingers. However, use of both hands is almost indispensable in all printing trades.

Speed with accuracy, mental alertness, neatness, patience, and the ability to work well with others are necessary. An artistic sense is an asset for many kinds of printing work. Perseverance is an essential quality, in view of the long apprenticeship period.

(Photo: NFB)

Newspapers have to be printed to meet deadlines. In order to do this, the composing-room staff must work together as a team, often under pressure.

PREPARATION AND TRAINING

Entry into the printing trades is almost wholly through apprenticeship. The age at which apprentices are accepted ranges from 16 to about 30. The Apprenticeship Commission in Montreal limits the maximum entry age to 20, with exceptions.

Printing workers, especially compositors and proofreaders, should have a fairly good general education, which includes a good grounding in the English or French language, or both, as the case may be. A high school education is preferred. The usual standard of education stipulated for apprentices is at least two years high school or its equivalent.

Applicants who have completed a technical or trade school course in a printing trade are more likely to be accepted for apprenticeship than those who are untrained. Technical schools in the larger centres in Canada and the bilingual *l'École des arts graphiques*, Montreal, offer industrial courses in printing that provide a very useful preparation for apprenticeship. An allowance is usually made for such training and the apprenticeship period correspondingly shortened.

Courses in art, such as drawing, design, colour and lettering, can be very helpful for many kinds of printing work.

Apprenticeship

The provinces of New Brunswick and British Columbia designate the printing trades for apprenticeship. The Apprenticeship Commission of the printing industry of the Montreal area, which represents both employers and unions, controls apprenticeship for that area.

Training programs in union shops are regulated by unions, in agreement with employers, and vary considerably according to craft and locality. In general, the apprenticeship period in both union and non-union shops lasts from four to six years, depending on the trade. The following summary shows the approximate length of time required for apprenticeship in the various printing trades:

Compositors (all types)...........	5 to 6 years
Electrotypers......................	5 to 6 years
Stereotypers......................	5 to 6 years

Photo-engravers	
Photographer	5 to 6 years
Stripper and Printer	5 to 6 years
Zinc Etcher	5 to 6 years
Copper Etcher	5 to 6 years
Router and Blocker	5 to 6 years
Finisher	5 to 6 years
Proofer	5 to 6 years
Tint-Layer	5 to 6 years
Lithographers	
Process Artist	4 to 5 years
Stripper and Layout Man	4 to 5 years
Lithographic Proofer	4 to 5 years
Photographer	4 to 5 years
Platemaker	4 to 5 years
Hand Transferrer	4 to 5 years
Lithographic Pressman[1]	4 years
Opaquer and Tuscher	2 years
Stone and Plate Preparer	2 years
Press Assistant	2 years
Pressroom Occupations (Letterpress and Gravure)	
Newspaper Pressman	5 to 6 years
Commercial Pressman	5 to 6 years
Pressman Assistant[2]	2 years (minimum)
Bindery Occupations	
Bookbinder (Male)	4 to 6 years
Bookbinder (Female)	2 to 3 years

[1] The four-years apprenticeship period is additional to the two years required to become a press assistant.

[2] This classification applies only to job shops. An apprentice must serve a period of at least two years before he can qualify as a press assistant. He then has the opportunity of registering as an apprentice pressman and, as such, is required to complete a special apprenticeship course of instruction and an additional two years of intensive training before he obtains his journeyman pressman's status. In the operation of newspaper presses there are only two classifications recognized — newspaper pressman and newspaper apprentice.

(Photo: Provincial Publicity Bureau of Quebec, Ciné-Photography Service)
Technical and trade schools in larger centres offer industrial courses in printing that provide useful preparation for apprenticeship. It is possible, however, to enter the trade as an apprentice without previous training.

Apprenticeship training usually includes, in addition to practical work on the job, classroom and correspondence work in related technical and other subjects. In areas where school facilities are not available, the greater part of the training is usually taken in the printing plant. In the Montreal area, in-plant training is complemented by technical instruction given at *l'École des arts graphiques* in Montreal.

Because of the continual changes that take place in printing methods and processes, journeymen frequently take further courses to bring themselves up to date. Such training is of particular value to those who wish to become specialists, foremen, supervisors or salesmen.

The ratio of apprentices to journeymen is quite rigidly controlled in the printing trades. It is therefore advisable for the would-be apprentice to get in touch with the appropriate union local and the owners of printing establishments. In this way, he can learn not only what the possibilities for apprenticeship are, but also the specific requirements. Guidance teachers and officers at National Employment Service local offices can help an applicant make these contacts.

WORKING CONDITIONS

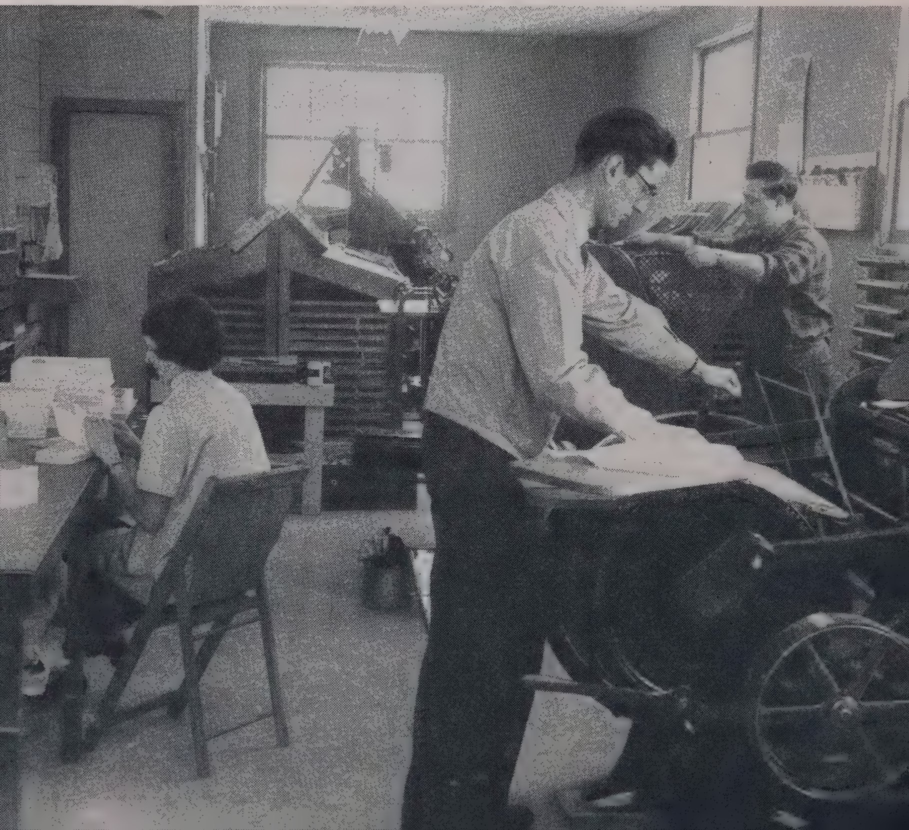
The printing trades are, in general, strongly organized, which benefits the workers not only in terms of wages and paid vacations, but also in security of tenure. The major printing unions are known for welfare provisions which include pensions, hospitalization and educational programs.

With some exceptions, the printing trades offer interesting work, especially in the skilled occupations. The steady development of new methods and processes adds interest to the work, and encourages further study.

Generally speaking, employment is steady and the standards of pay are good. The printing trades are affected only moderately by seasonal fluctuations and are not as hard hit as many other trades in times of economic depression. There are a variety of highly

An enterprising journeyman may branch out by operating his own printing shop. He must be a good businessman and know the printing trade thoroughly.

(Photo: NFB)



skilled jobs that a worker can enter, given the opportunity, after reaching journeyman standing.

Often the worker is under pressure to meet a time limit. In the newspaper and magazine field, night work may be involved, but there is usually the incentive of higher wage rates or other compensation for such work.

On the whole, working conditions are good, but the composing and pressrooms are unavoidably noisy. The usual occupational hazards associated with machines exist for bindery, press and other workers, and there is a slight risk of lead poisoning for machine compositors. These dangers can, however, be avoided with proper care. The accident rate is comparatively low.

Working conditions in the printing, publishing and allied industries were surveyed by the Department of Labour in April 1959. Returns from 459 establishments employing a total of 30,000 non-office workers show that

— 98 per cent of the workers covered were on a 5-day week;

— 95 per cent worked 40 hours a week or less;

— 81 per cent were in establishments granting two weeks vacation after less than three years;

— 27 per cent were in establishments granting three weeks vacation after 15 years;

— 91 per cent were in establishments granting 8 or more paid statutory holidays;

— 71 per cent had pension plans to which employers contributed;

— 85 per cent had group life insurance to which employers contributed;

— 64 per cent had a plan by which they received cash compensation for wage loss due to illness.

— higher rates for shift work were generally paid to tradesmen; in a number of cases the shifts were an hour shorter at night but the total daily pay was the same.

Wage Rates

Between 1949 and 1959, average wage rates increased nearly 84 per cent in the newspaper industry and nearly 70 per cent in job printing. *Wage rates for apprentices are based on a percentage of those current for journeymen.*

Average hourly wage rates for certain trades in the daily newspaper and job printing industries as at October 1959 are shown in the following tables. Current average wage rates would be higher than shown here becauses of new collective bargaining agreements made since then.

Average Hourly Rates in the Daily Newspaper Industry, October 1959

Locality	Standard Hours per Week[1]	Average Wage Rate per Hour (time work)	
		Compositor, Hand, and Linotype	Pressman
		$	$
Newfoundland —			
St. John's	40	1.75	1.75
Nova Scotia —			
Halifax	37½	2.56	2.56
New Brunswick —			
Saint John	40	2.05	2.05
Quebec —			
Montreal	37½	3.19	3.14
Quebec	40	2.16	2.13
Trois-Rivières	40—45[2]	2.05	2.05
Ontario —			
Hamilton	40	2.76	2.73
London	37½	2.77	2.77
Ottawa	37½	2.94	2.94
Toronto	37½	3.33	3.33
Windsor	37½	2.95	2.95
Manitoba —			
Winnipeg	40	2.31	2.26
Saskatchewan —			
Regina	40	2.15	2.15
Saskatoon	40	2.20	2.20
Alberta —			
Calgary	37½	2.40	2.40
Edmonton	37½	2.45	2.45
British Columbia —			
Vancouver	37½	3.07	3.07
Victoria	37½	2.89	2.89

[1] Standard hours for employees in the composing and press rooms.
[2] Compositor, 45; Pressman, 40

Source: Department of Labour, Annual Report on *Wage Rates, Salaries and Hours of Labour*, 1959.

Average Hourly Wage Rates in Printing and Publishing other than Daily Newspapers, October 1959

Locality	Standard Hours per Week	Wage Rate per Hour (time work)											
		Compositor, Hand		Linotype Operator		Pressman, Offset		Pressman, Cylinder		Pressman, Platen		Bindery Girl, Hand	
		Average	Predominant Range	Average	Predominant Range	Average	Predominant Range	Average	Predominant Range	Average	Predominant Range	Average	Predominant Range
		$	$	$	$	$	$	$	$	$	$	$	$
Newfoundland —													
St. John's.....	40—44	1.47	1.43—1.54	....	......	....	......	....	......	....	......	.65	.48— .82
Nova Scotia —													
Halifax........	37½-40	1.93	1.75—2.00	....	......	....	......	....	......	....	......	.74	.54— .92
Quebec —													
Montreal......	35-43¾	2.49	2.25—2.74	2.53	2.30—2.87	2.72	2.30—3.32	2.40	2.25—2.58	2.20	1.95—2.35	1.17	1.00—1.25
Quebec........	37½-40	1.97	1.95—2.00	....	......	2.17	1.95—2.25	1.95	1.93—1.98	....	......	1.08	.84—1.18
Ontario —													
Hamilton......	37½-40	2.34	2.22—2.47	....	......	3.03	2.50—3.38	2.35	2.24—2.45	....	......	1.26	1.10—1.38
London........	37½-42½	2.24	2.03—2.30	....	......	2.94	2.35—3.57	2.15	1.98—2.31	2.06	2.03—2.10	.98	.82—1.08
Ottawa........	38⅔-42½	2.33	2.00—2.45	2.38	2.30—2.45	2.44	1.90—2.85	2.29	2.00—2.40	1.89	1.65—2.30	1.10	.70—1.29
Toronto.......	35—44	2.60	2.59—2.70	2.65	2.59—2.72	2.81	2.27—3.44	2.41	2.34—2.50	2.31	1.90—2.48	1.23	.95—1.35
Windsor.......	37½-40	....	......	....	......	....	......	....	......	....	......	1.33	1.30—1.36
Manitoba —													
Winnipeg......	36¼-44	2.23	2.17—2.35	2.22	2.17—2.33	2.39	2.14—2.83	2.16	2.04—2.24	2.07	1.90—2.16	1.09	.90—1.15
Saskatchewan —													
Regina........	40	2.36	......	2.35	......	2.34	......	2.37	......	....	......	1.41	......
Alberta —													
Calgary.......	40	2.26	......	....	......	....	......	2.28	......	2.26	......	1.34	1.25—1.40
Edmonton.....	40	2.37	2.30—2.55	2.44	2.30—2.64	2.46	2.23—2.80	2.37	2.30—2.57	....	......	1.44	......
British Columbia —													
Vancouver.....	37½-40	2.73	2.67—2.89	2.75	2.67—2.96	2.86	2.67—3.25	2.81	2.67—2.89	2.67	2.45—2.86	1.68	1.56—1.72

Source: Department of Labour Annual Report on *Wage Rates, Salaries and Hours of Labour*, 1959.

ADVANCEMENT

The usual ladder of advancement is apprentice to journeyman to foreman to plant superintendent.

Although the tendency is for tradesmen to remain in the trade for which they are trained, men in the composing room, with a creative flair, may become designers and layout men in the advertising field. The man who has leadership ability and who has a thorough knowledge of his department may advance to foreman. A foreman possessing supervisory and managerial qualities, who is well versed in the mechanics of the presses used in all departments, is acquainted with engraving processes, and has some knowledge of pricing policies and other pertinent details, may become a plant superintendent.

Firms, such as printing machinery houses, paper companies, and ink manufacturers, sometimes prefer to employ skilled craftsmen as salesmen, or perhaps as technical men, since they are better able to cope with the problems of customers.

A good number of tradesmen have assumed the management of smaller newspapers or become proprietors of small job-printing shops.

PRINTERS' ORGANIZATIONS

The printing trades are highly organized in Canada, especially in urban areas. As a result, wages, working conditions and hiring policies are strongly influenced by unions. The closed-shop type of agreement is quite common, but some printing establishments are open shops or, in some cases, are covered by a company union.

There are several international unions of printing workers in Canada. These are organized by individual crafts; the different trades in lithography, however, are organized in the one union. The situation is slightly different in Quebec where the workers are organized either by the international unions or by a national union that covers all the printing trades.

The reader is referred to the publication *Labour Organization in Canada* prepared by the Department of Labour, Canada, for a listing of the national and international printing trade unions and the number and location of their branches.

DISTRIBUTION OF WORKERS

Geographic Distribution

The heavy concentration of printing employees in the central provinces is evident from the following table. More than three-quarters of the gainfully occupied were employed in Quebec and Ontario in 1958, employment in Ontario being double that of Quebec.

Distribution by Province of Production Workers in the Printing Trades, 1958

	Male	Female	Total	Per Cent Distribution
Canada	34,523	8,706	43,229	100.0
Nfld.	209	38	247	0.6
P.E.I.	109	22	131	0.3
N.S.	626	175	801	1.8
N.B.	447	106	553	1.3
P.Q.	9,332	2,074	11,406	26.4
Ont.	17,637	4,914	22,551	52.2
Man.	1,833	439	2,272	5.2
Sask.	710	154	864	2.0
Alta.	1,268	288	1,556	3.6
B.C. and Yukon	2,352	496	2,848	6.6

Source: Dominion Bureau of Statistics, *The Printing Trades*, 1958.

The regional distribution of the various printing trades shows the same pronounced concentration of tradesmen in the central provinces.

Percentage Distribution of Printing Tradesmen by Region, 1951

	Maritimes	Quebec	Ontario	Prairie Provs.	B.C.	Total No. in Canada
Bookbinders	3.4	33.6	47.9	8.6	6.5	3,219
Compositors & typesetters	5.5	28.3	45.9	12.4	7.9	15,253
Photo-engravers & lithographers	1.6	25.0	60.0	5.7	7.7	2,594
Pressmen & plate printers	3.2	28.3	52.8	9.6	6.1	5,588
Other bookbinding occupations	2.0	24.3	52.4	15.3	6.0	1,587
Other printing & publishing occupations	2.5	25.5	59.1	8.2	4.7	2,125

Source: *1951 Census.*

As is to be expected, most printing tradesmen are in the larger urban centres. The two cities of Toronto and Montreal bulk large in this employment picture. Together they employ 27 per cent of all compositors and typesetters, 39 per cent of all bookbinders, 38 per cent of all photo-engravers and lithographers, and 34 per cent of all pressmen and plate printers.

Percentage Distribution of Printing Tradesmen, by Selected Cities, 1951

	Montreal	Toronto	Vancouver	Winnipeg	15 Metropolitan Centres
Bookbinders	18.0	20.8	3.2	3.1	61.1
Compositors & typesetters	13.9	13.6	3.7	3.4	49.4
Photo-engravers & lithographers	15.0	22.6	5.1	2.2	59.4
Pressmen & plate printers	15.3	18.7	3.8	3.8	53.7
Other bookbinding occupations	12.4	16.1	3.6	2.5	61.2
Other printing & publishing occupations	14.8	20.8	2.6	3.5	58.8

Source: *1951 Census.*

Industrial Distribution

Most printing workers are employed in the printing and publishing industry but some are to be found in a number of other industries, such as paper products manufacturing, textiles, and trade and service industries, as well as in government service.

Percentage Distribution of Printing Tradesmen, by Selected Industries, 1951

	Printing & Publishing	Paper Products Mfg.	Trade	Service Gov't	Service Other
Compositors & typesetters	88.7	2.6	1.7	1.9	1.6
Photo-engravers & lithographers	84.2	2.5	2.2	2.0	0.8
Pressmen & plate printers	84.9	6.3	2.3	1.3	nil
Bookbinders	85.2	nil	3.1	2.5	4.1

Source: *1951 Census.*

Age Distribution

An examination of the distribution of printing tradesmen by age in 1951 shows that male bookbinders had a larger proportion (19.5 per cent) in the 55-and-over age group than the other printing trade groups. Compositors and typesetters came next with 13.8 per cent.

Age Distribution of Printing Tradesmen, 1951
(Percentages)

	Under 45	45-54	55+
Bookbinders			
Male	68.3	12.2	19.5
Female	79.5	12.5	8.0
Compositors & typesetters			
Male	72.6	13.6	13.8
Female	74.3	18.0	7.7
Photo-engravers & lithographers			
Male	78.5	10.9	10.6
Female	85.2	9.5	5.3
Pressmen & Plate printers			
Male	74.6	14.6	10.8
Female	87.3	8.7	4.0

Source: *1951 Census.*

TRENDS

Employment in the printing and graphic arts industry has increased markedly in the last few years. Data compiled by the Dominion Bureau of Statistics on the basis of establishments covered show that between 1939 and 1954 (the latest date for which statistics are available) employment in the industry rose by nearly 76 per cent to a total of 63,200. Throughout the entire period the employment trend was broadly upward. The graphic arts industry had suffered unemployment during the depression in the thirties but it recovered quickly and since then has had less unemployment, on the whole, than most industries in manufacturing. Since the end of the war, employment in the industry has kept pace with the upward surge in activity that has characterized the Canadian economy as a whole.

The above figures cover all categories of workers in the printing industry but the number of skilled and semi-skilled tradesmen in the industry has also grown considerably. Comparison of census figures for 1931, 1941 and 1951 bears this out, as the following table indicates.

Skilled and Semi-skilled Workers in Printing, Publishing and Bookbinding

	1931	1941	1951	Percentage Change 1941-1951
All tradesmen	22,773	23,324	32,978	+ 41
Male	19,721	20,062	27,010	+ 35
Female	3,052	3,262	5,968	+ 83
Engravers, lithographers and photo-engravers	1,759	2,007	3,523	+ 76
Male	1,756	1,946	3,345	+ 72
Female	3	61	178	+192
Printers[1]	—	17,232	20,841	+ 21
Male	—	16,399	19,661	+ 20
Female	—	833	1,180	+ 42

[1] Includes compositors, typesetters, pressmen and plate printers.
Source: *1951 Census.*

As the preceding table shows, printers are the largest group of tradesmen in the industry; in 1951, they made up 63 per cent. The number of engravers and lithographers has, however, increased markedly since 1941, reflecting the growing use of engraving and lithographic processes. This trend is likely to continue. Bookbinders, on the other hand, (not shown separately in

the table) are not increasing as rapidly as other trades. In 1951, less than 10 per cent of the tradesmen in the industry were in this group.

Although the number of women employed as either printers or lithographers is relatively small, it is interesting to note that the percentage increase between 1941 and 1951 has been substantial, both in these occupations and for the skilled and semi-skilled occupations as a whole.

Employment Prospects

The long-term trend in the employment of most printing tradesmen has been steadily upward and it is likely that this trend will continue for some time to come.

Mention has been made of the high proportion of tradesmen in the central provinces and in the larger cities. Because of this, openings should be more plentiful and of greater variety in these areas than elsewhere, particularly for photo-engravers, lithographers and bookbinders. The concentration of compositors and typesetters in the larger cities is not as marked, and many small-town printing shops that publish weeklies and do job work offer these tradesmen opportunities for employment. It can be expected, or course, that competition for jobs in the printing trades will be keenest in the large cities.

The majority of printing tradeswomen are employed in bookbinding occupations; relatively few in the other trades.

Approximately two-thirds of all printing tradesmen are to be found in the printers' group of occupations (compositors and pressmen). The likelihood is that the greatest number of opportunities will be in machine composing and press work. Monotype keyboard operation, monotype casting, electrotyping and stereotyping are expanding fields, but the number of openings that may occur here will be considerably fewer than for linotype operators and pressmen.

Expansion should also occur in the photo-engraving and lithographic fields. There is a shortage of photo-engravers at the present time, owing to the growing use of rotogravure and colour in newspapers and in the food packaging field. Similarly, the increasing use of illustrations and colour should benefit the lithog-

raphic trades and provide a greater demand for lithographers, pressmen, and other tradesmen skilled in colour work.

One of the biggest developments of recent years has been the remarkable growth of black and white offset printing. This kind of printing is now in keen competition with the regular letterpress on many types of work. It also appears probable that offset work will increase, which will mean a demand for more workers trained in offset methods.

Bookbinding has, in the process of mechanization, become an occupation needing a smaller proportion of fully skilled workers. The trade is dependent upon the demand for books and is directly affected by economic conditions. The long-term trend for all-round bookbinders will probably continue downward.

Seasonal unemployment is not very common in the printing trades, the number of workers employed throughout the year being quite constant. Adverse economic conditions affect certain types of printing more than others, less so in the newspaper field and more so in the job printing field. A high level of business makes for a high demand for printed products and advertising materials; consequently, printing tradesmen who are employed in establishments dependent on this demand are more affected by a low business level.

Technological Change

Some consideration must be given to the probable effects of technological changes on opportunities for printing tradesmen. The introduction of the composing machine has resulted in fewer jobs for hand compositors. Advances in presses have changed the character of the pressmen's work. There has been rapid improvement in the offset printing process, both in reproduction and in presses.

The demand for machine compositors in the newspaper field has been affected to some extent by the introduction of the teletypesetter. Most of the typesetting required by a newspaper is still, however, done by linotype and monotype operators. The teletypesetter can transmit copy to a number of newspapers in the form of perforated tape which, when fed through an attachment on a linotype machine, causes type to be set automatically. This machine is mainly used by newsgathering agencies, such as the Canadian Press, to service its member newspapers.

Most shops are using the printing methods and equipment previously described. In some shops, however, photo-typesetting machines and new makeup methods are supplanting conventional metal type methods. It is likely that these new machines will come into wider use as time goes on.

Where photo-typesetting machines are used, layout is done on a master form, indicating where borders, lines, illustrations, display type or other type material are to be placed. In paste makeup the workman places film or paper in position on the master form, as he would type or cuts in the metal types process. The completed master is checked, proofread, then photographed, and a printing plate made.

Some of the new photo-typesetting machines have the same function as the linotype, intertype and monotype machines — to produce type material by keyboard operation. Instead of casting metal slugs, however, these new machines have built-in cameras that produce type material set up line by line on a roll of photographic film, which is developed in the darkroom.

Most of the lines of large display type are composed on photo-lettering machines. The type material is in the form of strips which, depending on the type of machine used, may be developed in the darkroom or in the machine itself.

Although radically different from conventional metal type methods, the new processes still require a thorough understanding of the graphic arts. In shops where these changes are being made, journeymen are being trained in the new methods, as are apprentices after they have received basic training in the metal type methods.

Technological change has, in the past, gradually altered the character of the printing trades and will continue to do so in the future. The established trades, and those that have come into being recently, offer good opportunities in a steadily expanding printing industry, an industry which plays a vital role in the lives of Canadians.

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Filmstrip:—

The Department of Labour has collaborated with the National Film Board in producing the filmstrip *Printing Trades* based on this monograph. It describes, with authentic pictures, the nature of the work, training, working conditions, employment outlook, and other aspects of the trades.

LOCAL INFORMATION

LOCAL INFORMATION

LOCAL INFORMATION

LOCAL INFORMATION

CANADIAN OCCUPATIONS FILMSTRIPS

The Department of Labour has prepared, to date, the following occupational filmstrips in collaboration with the National Film Board. A manual has been prepared as an accompaniment to each filmstrip.

Plumber, Pipefitter and Steamfitter
Careers in Engineering (revised, in colour)
Social Worker
Technical Occupations in Radio and Electronics
Bricklayer and Stone-Mason
Printing Trades
Careers in Natural Science (revised, in colour)
Careers in Home Economics
Motor Vehicle Mechanic
Mining Occupations
Draughtsman
Careers in Construction
Machine Shop Occupations
Sheet-Metal Worker
Careers in Meteorology
Medical Laboratory Technologist (in colour)
Teacher (in colour)
Office Occupations (in colour)

These may be purchased from the National Film Board, Box 6100, Montreal, or from any one of its regional offices.

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The Social Worker (b & w)
Bricklayer and Stone-Mason (b & w)
Printing Trades (b & w)
Careers in Natural Science (colour)
Careers in Home Economics (b & w)
Motor Vehicle Mechanic (b & w)
Mining Occupations (b & w)
Draughtsman (b & w)
Careers in Construction (b & w)
Machine Shop Occupations (b & w)
Sheet-Metal Worker (b & w)
Careers in Meteorology (b & w)
Medical Laboratory Technologist (colour)
Teacher (colour)
Office Occupations (colour)
Electrical and Electronic Occupations (colour)
Careers in Library Service (colour)
Electronic Computer Occupations (colour)

Canadian Occupations
Monograph 9

PRINTING TRADES

Prepared
by the
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Department of Labour, Canada

HON. ALLAN J. MacEACHEN — *Minister*

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FOREWORD

During recent years there has been a steadily increasing demand for Canadian occupational information. The demand comes from young people faced with the need of choosing an occupation and preparing for it; from parents, teachers and vocational guidance counsellors; from workers wishing to change their occupations; from employment service officers; from personnel directors and union officials; from prospective immigrants to Canada, and from other quarters.

The CANADIAN OCCUPATIONS series of monographs is designed to help meet this demand. Each booklet describes, among other things, the nature of the occupation or group of occupations, entrance and training requirements, working conditions and employment outlook.

The series has been prepared with the generous assistance of representatives of management, trade unions and professional associations. The co-operation of the Unemployment Insurance Commission, the Technical and Vocational Training Branch of the Department of Labour, and the Dominion Bureau of Statistics is gratefully acknowledged.

Occupational information tends to become dated as a result of change in economic conditions, in industrial technology and in wage and salary structure. Revision of outdated publications is a regular feature of the series.

This revised edition of *Printing Trades* was prepared for the Manpower Resources Division by Mary E. Stuart and William Allison, Chief of the Occupational Analysis Section.

J. P. FRANCIS,
Director,
Economics and Research Branch,
Department of Labour.

June 1964.

CONTENTS

Printing bank notes is a highly specialized craft. This is only one of the more than 2,800 printing establishments in Canada.

Photo: British American Bank Note Co. Ltd.

PRINTING TRADES

HISTORY AND IMPORTANCE

The term "printing" is applied to the art of impressing letters, figures, etc., on paper or other substance. History records that the Chinese, as far back as 868 A.D., duplicated the written word by means of wooden blocks carved in relief. It was not until the fifteenth century, however, when Gutenberg in Germany invented movable type and the hand-operated printing-press, that the way was opened for the rapid growth of the printing art, and the extension of learning and culture to men everywhere.

Up to that time, Europe knew only the hand-written books of the skilled scribe — books that were scarce and expensive. In the printing-press a less expensive medium was found, which permitted a more rapid spread of information. Greek and Roman classics in printed form were soon in general use. Men's minds were stimulated and found expression in the enlightened thinking of the Renaissance.

Printing has rightly been called "the art which preserves all the arts" and the "Mother of Progress". It is difficult to think of any activity in which the printed word does not play a part. It is used not only for social, scientific and cultural purposes, but also for the conduct of government, business and industry. The expansion of free education to all classes during the past century created a greatly increased demand for printed matter.

The present status of the printing industry is largely the result of new machines and processes introduced in the nineteenth century. These, together with cheaper paper-making methods, so reduced printing costs that the demand for the printed product was greatly stimulated.

One can but briefly review here some of the important changes that took place in that century. The first paper machine making a continuous web of paper was successfully started in England in 1804. The high cost of paper made from rags hindered the natural growth of the industry for many years. After 1860, the production of paper from wood pulp had a striking effect on the availability of paper, especially newsprint, at reduced costs. Canada, through the development of its vast pulpwood resources, has played a major part in the supplying of newsprint to the printing industry the world over. More than forty nations, including the United States, depend on Canada for much of their newsprint.

Job presses were greatly improved in the second quarter of the nineteenth century; the first rotary press in America appeared in 1865; the linotype and monotype typesetting machines, in the 1880's. Stereotyping, photo-engraving and lithographing processes were also introduced in the nineteenth century, but modern lithography is a quite recent development.

These new machines and processes made for the growth of a highly skilled body of tradesmen who form the backbone of the printing industry.

There is a considerable variation in the size of printing plants and in the type of work they produce. There are job or commercial printing plants which range from the one or two-man shop to large establishments using batteries of typesetting machines and presses. This group includes plants capable of producing any type of printed matter. Some job shops specialize in one or more of such printing processes as lithography, photo-engraving, electrotyping and stereotyping. Also within this field are service shops (trade plants), which do specialized work for other printing plants.

In addition there are newspaper establishments, magazine and book publishing houses. The two former may also do job work.

The printing industry is also important from an economic standpoint. In 1960, the last year for which Canadian statistics are available[1], total production exceeded \$772 million. During the year, 2,983 establishments were in operation, employing about 69,000 workers. Salaries and wages paid amounted to approximately \$304 million.

This monograph deals mainly with the skilled and semi-skilled trades, which are learned through apprenticeship training. More than half of the working force of the printing industry is made up of such tradesmen.

[1] Dominion Bureau of Statistics, Annuals, (1960) Cat. No. 36-209, 36-210 and 36-212.

PRINTING METHODS AND PROCESSES

The printing process begins when copy, in the form of written text and photographs or drawings, is received from the author. Three principal methods of reproduction are *letterpress*, *lithography* and *gravure*.

Letterpress, (known as relief printing because the printing surface which receives the ink is raised above the rest of the type) is the oldest and most common form of printing. It is in the letterpress method that we find the traditional printing trades.

In lithography the press plate is smooth, as both the printing and non-printing areas are on the same level. Using the principle that water and grease repel each other, the printing area is coated with a greasy substance and the plate is moistened with water. When ink is applied it is absorbed by the greasy printing surface

...ting of money requires great care and attention to detail. Here a pressman is ... cleaning engraved plates or "form". (Photo: N...

but is repelled by the water. In printing, the image is transferred to an intermediate rubber roller and then offset to paper.

In gravure printing, the printing area is etched below the surface of the plate. The whole plate is inked, then wiped, leaving ink in the depressions only. The suction that is created when paper and plate come together draws the ink out from the depressions onto the paper. This method gives finer reproduction than either letterpress or lithography and the plates stand up better than letterpress on long runs. On shorter runs, lithography has certain advantages over gravure.

The etching for gravure may be done by hand or machine, or it may be done by photography (*photogravure*). Examples of printing by hand or machine-engraved plates are engraved stationery and greeting cards, and printed metal foil. A common form of photogravure is the newspaper picture supplement, known as *rotogravure* because the engraving is done on cylindrical copper plates.

A fourth and less well-known form of printing is the *silk-screen* process. This is a form of stencilling that has been developed for the printing of textiles, glass, posters and other items where there are large areas of colour, particularly when fluorescent inks are used. The stencil is mounted on a fine-mesh silk or metal screen and the colour is forced through, giving a facsimile of the original design.

Stencil cutting, plate making and photography, the skilled operations in the process, are done by craftsmen trained on the job in their particular specialty. Other silk screen operations can be learned in a few weeks of on-the-job training.

NATURE OF THE WORK

Any printing establishment is concerned essentially with four things: type setting, plate making, press work and book binding. Within these four areas there are a large number of occupations which vary from highly skilled to unskilled.

In small plants one or two men may carry out all the duties involved in composing, printing, and binding, but in the large plants each of these functions is carried out by special departments, and within each department the work is broken down into a number of specialized operations.

The following is a brief outline of the main skilled and semi-skilled trades that may be found in a printing establishment.

Typesetting

The term *compositor*, *typesetter*, or *typographer* applies to anyone who sets type by hand or machine. Before the introduction of the linotype machine, all typesetting was done by hand. Today, however, the machine is to the fore, but hand composing still plays an important part. In some small shops all the type is still set by hand. Many shops use machines for "straight matter", and headlines, titles and other display type are set by hand or with the Ludlow machine. It is of primary importance that the apprentice learn hand typesetting before he proceeds to machine work.

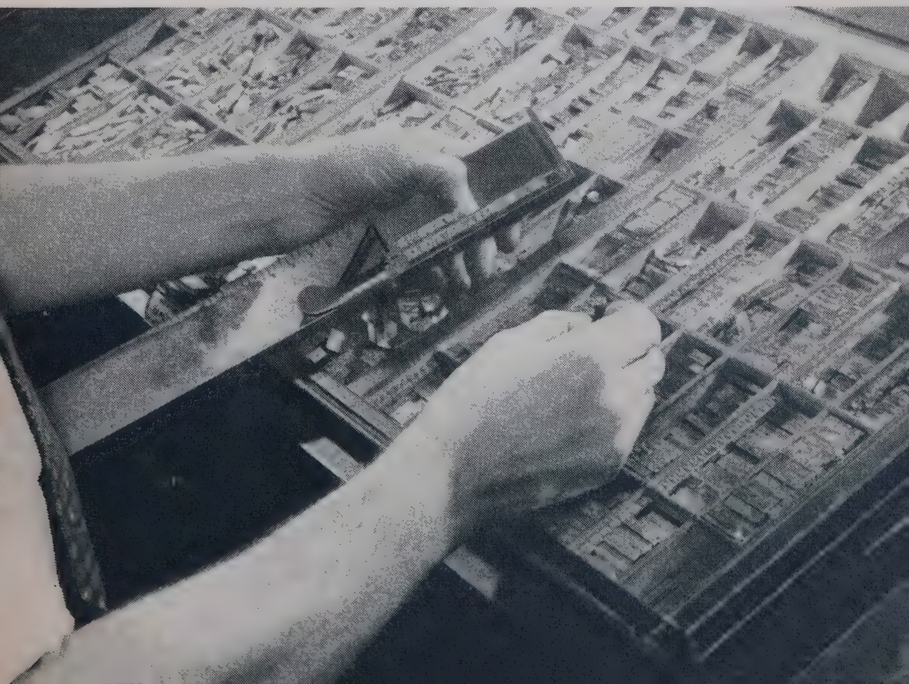
The *hand compositor* sets type by hand, letter by letter, with proper spacing, in a composing "stick". When the stick is full, the lines of type are transferred to a metal tray or "galley". Among other things, he may, especially in small shops, assemble machine and hand-set type, pull proofs of type-forms, proofread, correct typesetting errors, and do "make-up", that is, arrange type and engravings into pages.

The *linotypist* operates a machine that has a keyboard similar to that of a typewriter but with different arrangement and action. (The Intertype machine is similar to the Linotype.) After he completes a line of type, the linotypist works a lever and the machine automatically casts the line of type in a solid strip of metal known as a "slug". Each slug is automatically trimmed, and placed in a galley. The linotype machine is used for newspaper, magazine, book and some job work.

The monotype machine differs from the linotype in that it casts each character separately instead of a line at a time; also the typesetting is done in two steps instead of one. The *monotype keyboard operator* operates a keyboard that punches holes in a paper ribbon. The ribbon is then put through a monotype casting machine by the *monotype caster operator*. This machine casts each character separately, according to the arrangement of holes. The advantages of the monotype machine are that it permits single letter corrections, and makes a better job of spacing letters and words. It also handles tabular matter more efficiently, especially where vertical ruling is required. In the linotype, corrections must be made by entire lines. The latter machine, however, gives a greater rate of production. The monotype machine is used mostly for book and periodical work and for some commercial printing.

The *Ludlow operator* combines hand and machine work. Individual letters or words are set by hand and the Ludlow machine casts them into slugs.

h font (a complete set of one size of type) consists of 137 characters, including er and lower case letters, numbers, punctuation, etc. Compositors use a ety of fonts when preparing material, selecting characters from trays and ng them in the composing stick to form lines. (Photo: N

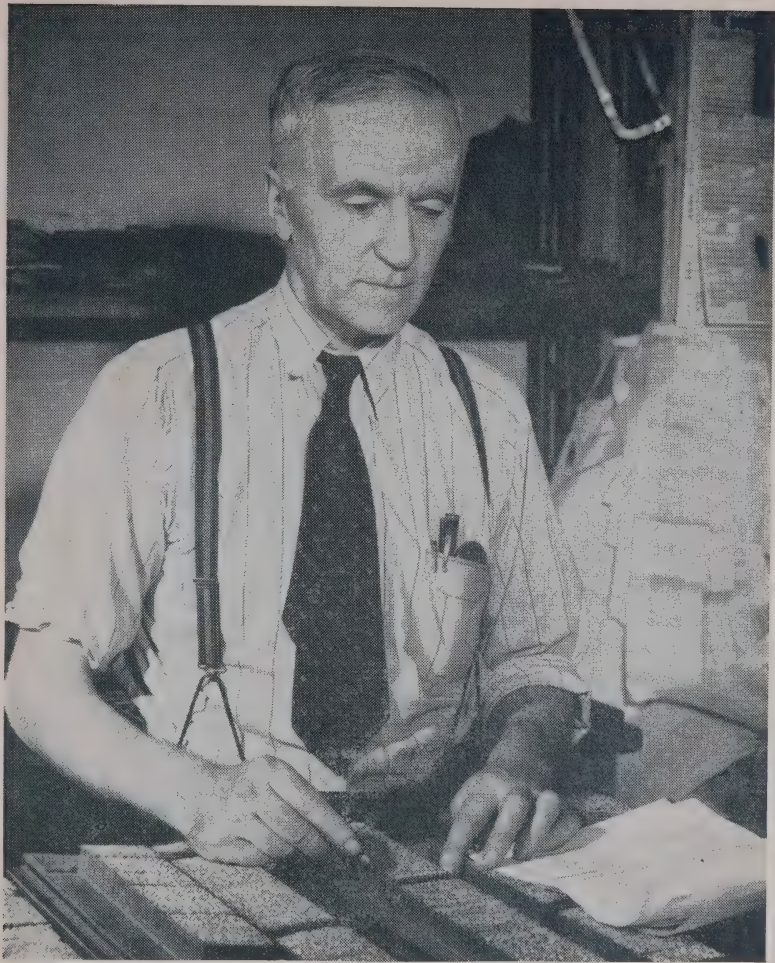


As the linotype operator presses the keys, individual letter moulds that form the type are collected in a line. When a line is completed, it is automatically positioned to receive molten lead. The lead quickly hardens and the completed line or "slug" is ejected into a receiving galley.

(Photo: NFB)

The stoneman prepares type for the press, making sure that everything is in position and that type is standing erect and level in the "chase".

(Photo: NFB)



(Photo: NFB)

The compositor receives proofs from the proofreaders and makes necessary corrections, revisions and additions in the standing type. When all is in order, he arranges type and illustrations into pages ready for the stoneman.

When all the typesetting is completed and has been placed and arranged in galleys by the *bankman*, proofs are pulled and are checked by *proofreaders* against the original copy for typographical, grammatical or compositional errors. *Copyholders* assist the proofreaders. In small shops, journeymen typesetters and advanced apprentices may do the proofreading. (Galley proofs are also commonly submitted to authors, editors or others responsible for the preparation of copy, before the final make-up of pages takes place.)

After corrections have been made by the compositors, the galleys of type are divided into desired lengths and, together with photo-engraved illustrations, page numbers, etc., are placed on a large, smooth steeltop table, known as a "stone", where they are arranged into pages by the *make-up man*. The *stoneman* then levels the type and locks the completed form in a chase (a steel rectangular frame). A final check is made by the *line-up and lock-up man*, who relock the form in the chase (so that it will lift without spilling any type), after making certain that all type stands firmly upright and level and the margins are correct. The forms are then ready for the press, or for electrotyping or stereotyping.

Journeymen in the composing room, whether "all-round men" or "specialists", are usually trained in all its activities. There is thus a high degree of transferability among jobs in the composing room, especially in small shops.

Plate Making

Photo-engraving, *electrotyping* and *stereotyping* are complementary to letterpress printing. In photo-engraving, plates are made of copy that cannot be set up in type, such as illustrations. A photographic negative is printed on a copper or zinc plate that has been treated with a light-sensitive coating, and then etched with acid to make the illustration stand out in relief.

Stereotyping and electrotyping are used to make duplicate press plates of type-forms and photo-engravings. Stereotypes are used mainly in newspaper work; electrotypes, which are more durable, for books and magazines.

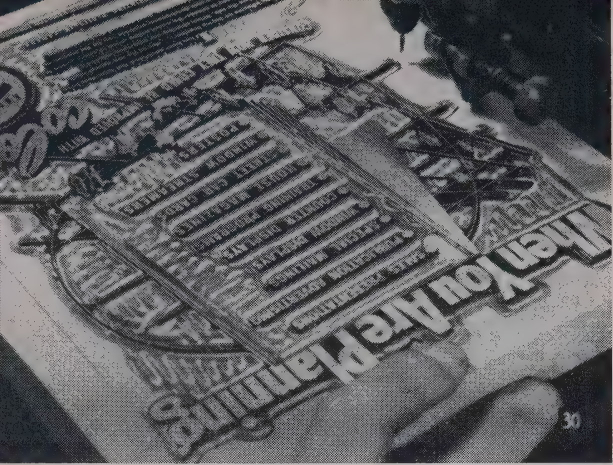
It may be asked why electrotyping or stereotyping is necessary when the original type-form is available. One reason is that type-forms are flat and cannot be curved to fit the cylindrical plate holders on rotary presses. Also, long runs of magazines, books or newspapers require several plates to preserve a clear print. Several presses may be used simultaneously to speed the work. It is simpler, faster and cheaper to duplicate type-forms by electrotype and stereotype than to use several original type-forms.

Photo-engraving

There are three different ways in which photo-engravings are made. *Line-etching* is cheap but it gives very little shading. The *half-tone* process gives finer detail and shading. In this process, copy to be reproduced is photographed through a fine cross-lined screen, resulting in a negative film on which the image is in the form of dots. The spacing and size of the dots determines the black, shaded or white portions of the picture (examine the various half-tone illustrations in this booklet). In both line-etching and half-tone the printing surface is raised as in letterpress printing. *Photogravure*, the third process, has the image etched below the surface.

Photo-engravers are mainly engaged in producing plates for letterpress printing, but are also employed in rotogravure work.

The skilled photo-engraver is capable of performing all of the operations involved in the process. In a large service shop, however, the whole job may be done by a number of photo-engravers, each specializing in certain operations, such as photography, printing, etching and finishing.

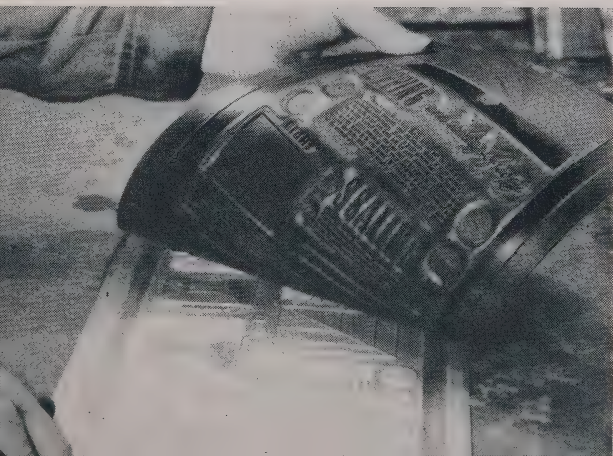


A photo-engraved plate is mounted on a block of wood or metal to bring it to the required height for printing.

(Photo: Rapid Grip and Batten Ltd., Montreal)

This papier-mâché mat has come from a hydraulic press where it was under about 400 tons pressure. The stereotype moulder removes it from the type-form and checks it for imperfections.

(Photo: NFB)



An electrotype stripper removes the thin copper coating from the mould. The "shell" is then backed with lead to give it the required rigidity and thickness.

(Photo: Rapid Grip and Batten Ltd., Montreal)

In letterpress work, the photo-engraver may perform one or more of the tasks involved in reproducing photographs, drawings, paintings, and other illustrations in relief on zinc or copper plates: photographs illustrations to make line plate, half-tone, or colour half-tone; develops negatives and sets them in drying oven; strips negatives from photographic plates, places them in reverse position on piece of glass, and sets glass and negative over sensitized metal plate; exposes plate for several minutes; etches plate with acid so that the image stands out in relief; trims and mounts plate; corrects imperfections in the design; prints sample copies to check for errors.

The rotogravure photo-engraver performs work similar to the letterpress photo-engraver. In this case, the plate to which the image is transferred, instead of being flat, is a copper cylinder with a highly polished surface.

Stereotyping

In stereotyping, a mould is made by pressing a wet papier-mâché mat against the type-form. When the mould dries and hardens, molten type metal is poured into it, and the result is a metal casting which is a reproduction of the original type-form.

The main trades in stereotyping are:

Stereotype Moulder	— makes the impression of the type-form in the mat (consisting of flong or papier-mâché) by means of a press.
Mat Trimmer and Backer	— trims the edges of matrices (impressed mats) and reinforces backs of matrices so that they will not bend during the casting process; dries the matrices under steam pressure.
Stereotype Caster	— operates a machine that pours molten type metal into the mat.
Plate Finisher	— levels stereotype plates, smooths back of plate for mounting, bends plates to cylindrical form for use in rotary presses; routes both flat and circular plates for black and white and colour work.

Electrotyping

Duplication is achieved in electrotyping by using a wax or plastic composition, instead of a papier-mâché mould. After receiving the impression of the type-form, the mould is chemically treated. By the process of electrolysis, the mould is coated with a thin film of copper or nickel to form a duplicate of the original. The

copper or nickel impression is taken from the mould. backed with lead and mounted, ready for the press.

The main trades in electrotyping are:

Electrotype Mould Builder	— prepares wax and plastic composition moulds.
Electrotype Moulder	— impresses the type or photo-engraved plate forms in moulds.
Batteryman	— operates a plating bath to electroplate copper, lead or nickel on the graphite covered faces of lead, wax, or resinous moulds, to form reproductions, in plate form, of type set-ups for use in printing.
Electrotype Stripper	— removes shells (thin, electrically deposited coatings of copper or nickel) from moulds.
Plate Finisher	— trims and levels electrotype plates, smooths back of plate for mounting, bends plates to cylindrical form for use in rotary presses.
Electrotype Caster	— pours a backing of lead on electroplate shells to strengthen them for use in printing presses.

Lithography and Photo-offset

Up until the early 1900's, lithographic work was produced from drawings on stone (*lithos:* stone); since then metal plates have been adopted because they can be curved to fit the cylinders of modern lithographic rotary presses, permitting speedier reproductions. Some plates are still made by hand but in most cases they are made by transferring the desired image from a photographic negative to the light-sensitive metal plate, a process known as photolithography.

(Photos: NFB)

Illustrations and text matter prepared by the layout man is positioned in front of the camera and the photographer makes a negative.

Some of the principal occupations in lithography are:

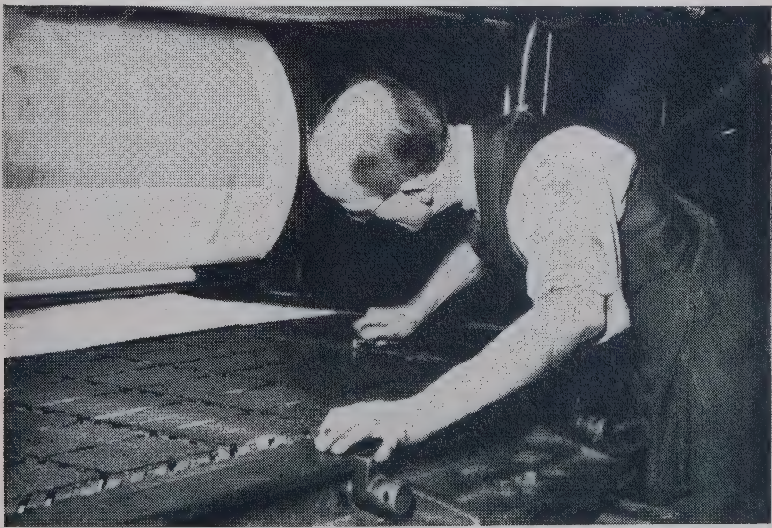
Lithographic Artist	— copies or creates designs on lithographic stones to be engraved by the "stone engraver", using soft, greasy crayons. In photolithography, he retouches negatives or positives by hand with chemicals and dyes. Corrects colours in final press plates.
Stone Engraver	— cuts designs of type or illustration copy into the surface of lithographic stones, using hand and machine tools.
Photolithographer (Cameraman)	— photographs in artificial light either illustration or typeset material to prepare a positive print (or a negative) for use in lithographic printing, enlarging or reducing print (or negative) to desired size. May use screen to break up shading of copy into dots for half-tone printing. May use colour filters to prepare various plates for colour printing.
Stripper and Layout Man	— lays out the film or films on a large press-size glass plate or light opaque paper in order to obtain a final layout in accordance with the job specifications.
Plate Preparer or *Grainer*	— prepares the faces of zinc or aluminum plates for use as lithographic printing plates by roughening (graining) with a machine which rotates steel or wooden marbles and wet pumice or sharp sand over the surface.
Transferrer (Press Platemaker)	— transfers images by hand or machine from photographic negatives or positives to zinc plates for printing by the lithographic process. To effect a transfer by hand, the transferrer covers surface of grained zinc plate with a coating of photosensitive chemicals and allows plate to dry; the photographic negative or positive is placed on the plate and an exposure is made under strong artificial light, thus transferring the image from photograph to the plate. In the machine process, photograph and plate are placed in a vacuum frame or photocomposing machine and an exposure is then made. After the plate is developed, it is chemically treated, so that when moisture is applied to the press plate, the image areas will receive the greasy ink and the non-image areas will repel it.

Press Work

So far we have traced the work process in printing from the composing room, where the type was set, to the making of press plates by electrotyping, stereotyping, photo-engraving, rotogravure and lithographic processes. The next stage is the pressroom, where the actual printing is done.

The *pressman* operates a press or presses and is responsible for all work involved in printing. His duties include setting the forms or plates in place on the press, "making ready" (running a few samples through the press to ensure that the impression is even, and making final adjustments where necessary), seeing that the flow of ink is correct, and examining press sheets from time to time during the run. The pressman, who must be a journeyman, may be aided by *press assistants*, or other journeymen (in the case of large, automatic presses), who work under his direction.

There is a distinction between *press assistant* and *press feeders*. Many printing presses are now equipped with automatic feeders so that press feeders have been largely eliminated and replaced

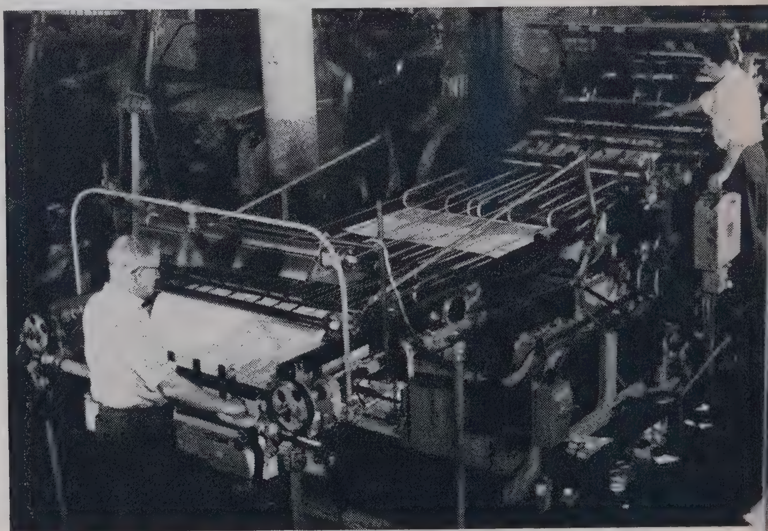


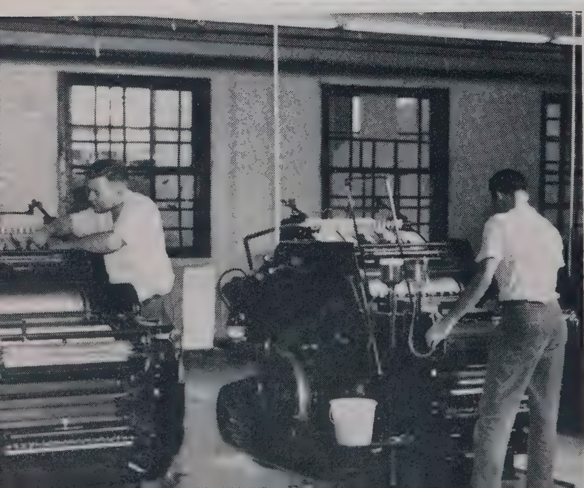
(Photo: NFB)

Pressmen and their assistants make regular checks of the printed material as it comes from the press. If anything goes wrong they stop the press, make adjustments, and run off a few copies to make sure everything is operating properly again.

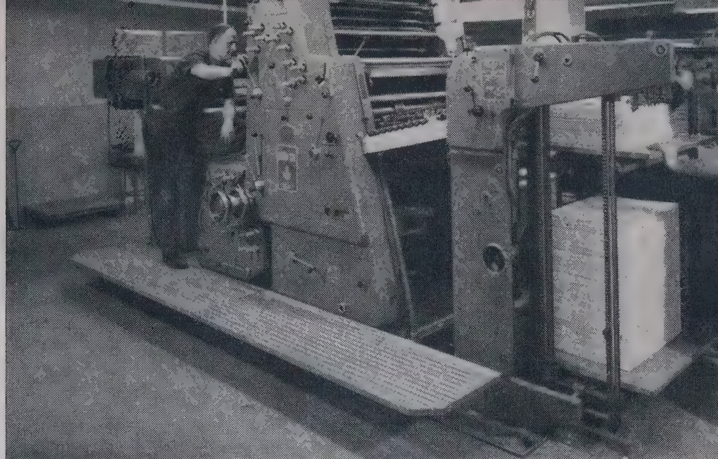
PRESSES

Proof copies are "pulled" to examine the accuracy of typesetting and quality of engraving. The equipment depicted will quickly produce a large number of impressions.





These automatic presses require little attention once they are set for a production run.



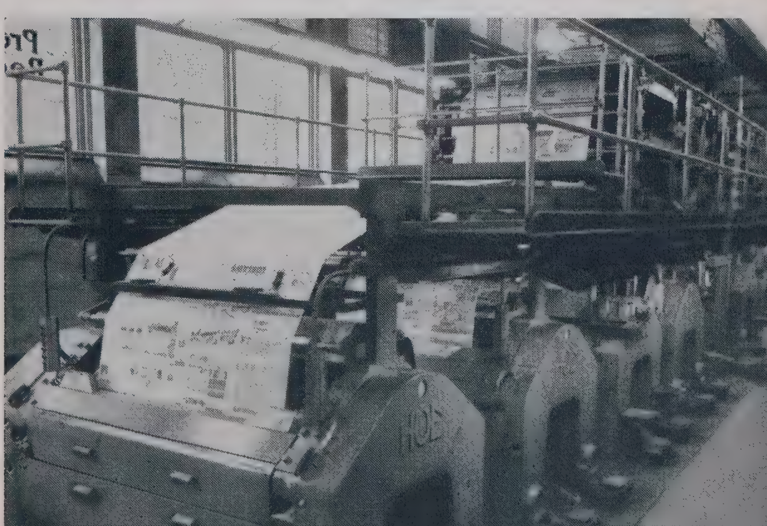
Setting up the ink and paper feeds on a lithographic offset press prior to a two-colour run.

Cylinder presses are used for printing books, as they can print many book pages on one large sheet of paper.

(Photo: NFB)

A six-unit high-speed rotary press can turn out over 46,000 48-page newspapers per day.

(Photo: Bill Lingard — Photo Features, Ottawa)



by press assistants. These workers are qualified to perform the duties involved in the care of equipment and accessories, loading automatic feeding devices, and assisting in preparing the make-ready. Press assistants may perform any or all of the duties of pressman, under the direction of a journeyman pressman.

Because of the variety of presses and the different methods of printing, the pressman's work varies. In small printing establishments, pressroom workers are usually required to operate more than one type of press and may also set up type by hand. In the larger commercial printing plants, press workers usually specialize in the operation of one kind of press. Some of the main types of press are as follows:[1]

Platen Press	— consists of a frame supporting two flat surfaces — a vertical, stationary surface on which the type-form is locked, and a surface (called the platen) that moves from a horizontal to a vertical position in the printing process. The paper is placed upon the platen and is pressed against the type-form. Platen presses may be hand or automatically fed.
Cylinder Press	— consists of a revolving cylinder, or drum, that carries the paper and is mounted above the flat bed of the press. The type-form is locked on the flat bed and is moved forwards and backwards with a shuttle motion underneath the cylinder. This press may be automatically or hand fed and may be a one or two-colour press.
Rotary Press (*Sheet Fed*)	— consists of two revolving cylinders, mounted parallel to each other, one carrying the paper, the other the printing plate. The paper is fed either by hand or automatically.
Rotary Press (*Roll Fed*)	— also known as a web-rotary press and generally used for large quantity printing in newspaper, magazine, and book work. There are two types, one for black-ink printing, the other for colour work. This press is basically a series of synchronized rotary presses which are automatically fed by one or more rolls of paper at a time. The web-rotary press does the complete job of printing: it prints on both sides of the paper; cuts, assembles and folds the pages; counts the number of copies printed. For full production, the web-rotary press requires a crew of five or more workers.

Specially designed rotary presses, calling for different techniques, are used in offset and gravure printing.

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[1] Description of presses adapted from *Pressroom Occupation* in the "Occupational Guide" series issued by the Michigan State Employment Service, Detroit, Michigan.

Bindery

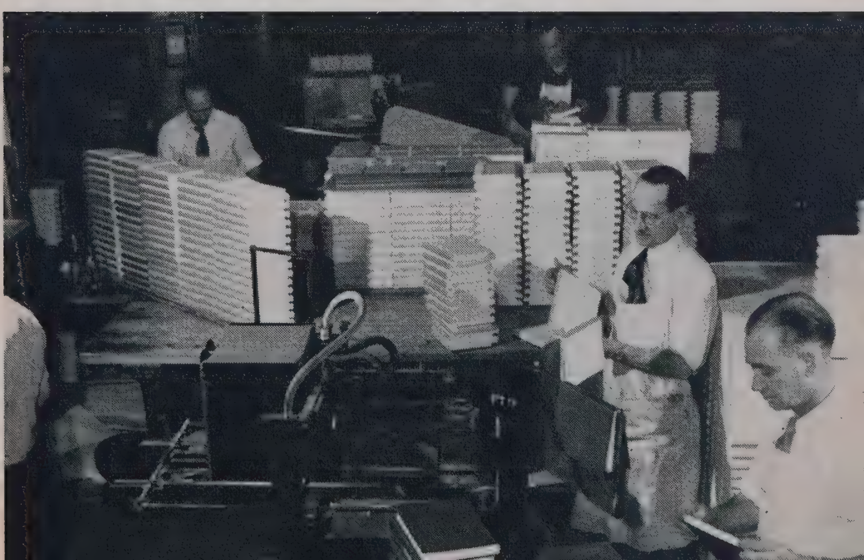
Many printed products, such as newspapers, business forms, labels, etc., require no further work after they leave the press. Books, magazines, pamphlets and folders, however, are put into final form by bindery workers. Many of the bindery jobs are done by women. Such jobs are folding, gathering sheets or collating sections to form books, operating punching and stitching machines, and hand sewing. Jobs such as hand bookbinding, book finishing, embossing, and operating the more complicated types of machines are usually done by journeymen.

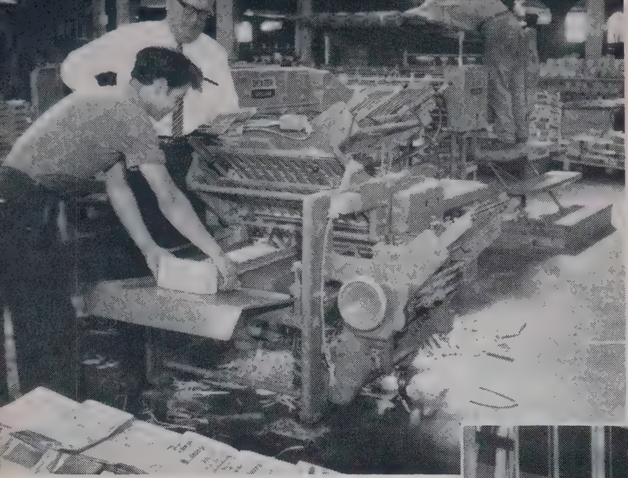
Bookbinders perform all or several operations in affixing covers to sewed-together signatures. They fold and place the signatures in a hand press to reduce the size of the book, trim pages to size and round corners, apply glue to the backs of the signatures to stiffen the back of the book body, and shape them to receive the cover. In some cases, plain colours or a mixture of colours that give the appearance of marble are applied to the outside edges. Then the finished covers are glued to the end sheets and the completed books placed in a press to dry.

The bookbinder or a *book embosser* embosses the design or title on the book covers with hand tools, using gold, silver or colour.

Bookbinders are fitting the cover to the body of the book and checking for irregularities before sending it to the drying press. Much of the work is now done by machine.

(Photo: NFB)



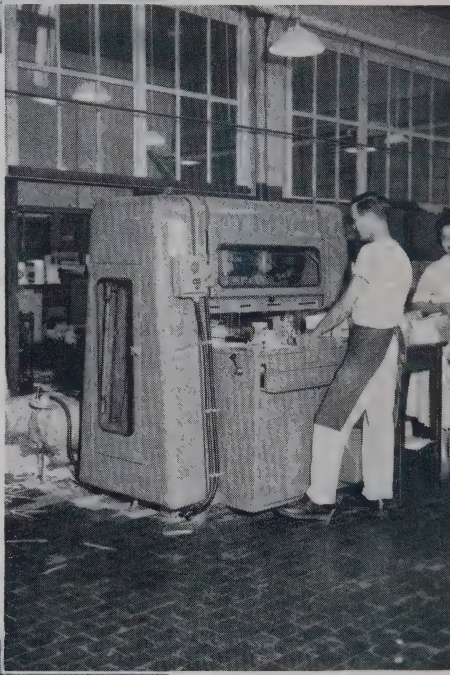


Among the many machines operated by workers in the bindery department are:

*Above —
a folder and trimmer*

*Centre —
a three-knife trimmer*

*Below —
collating, stitching and trimming in one operation.*



PERSONAL QUALITIES NEEDED

Most of the printing trades call for good eyesight, about average physical strength, and a high degree of manual dexterity. Colour-blindness is a serious handicap in the pressroom, as is left-handedness in the composing room. Some printing trades can be undertaken by those with certain physical handicaps. Workers with speech or hearing defects, or both, have found employment as hand and machine compositors and in most of the other printing trades. Some composing-room occupations are suitable for those who have suffered the loss of one or both legs, or who do not have the use of all their fingers. However, use of both hands is almost indispensable in all printing trades.

Speed with accuracy, mental alertness, neatness, patience, and the ability to work well with others are necessary. An artistic sense is an asset for many kinds of printing work. Perseverance is an essential quality, in view of the long apprenticeship period.

(Photo: NFB)

Newspapers have to be printed to meet deadlines. In order to do this, the composing-room staff must work together as a team, often under pressure.

PREPARATION AND TRAINING

Entry into the printing trades is almost wholly through apprenticeship. The age at which apprentices are accepted ranges from 16 to about 30. The Apprenticeship Commission in Montreal limits the maximum entry age to 20, with exceptions.

Printing workers, especially compositors and proofreaders, should have a fairly good general education, which includes a good grounding in the English or French language, or both, as the case may be. A high school education is preferred. The usual standard of education stipulated for apprentices is at least two years high school or its equivalent.

Applicants who have completed a technical or trade school course in a printing trade are more likely to be accepted for apprenticeship than those who are untrained. Technical schools in the larger centres in Canada and the bilingual *l'Institut des arts graphiques*, Montreal, offer industrial courses in printing that provide a very useful preparation for apprenticeship. An allowance is usually made for such training and the apprenticeship period correspondingly shortened.

Courses in art, such as drawing, design, colour and lettering, can be very helpful for many kinds of printing work.

Apprenticeship

The provinces of New Brunswick and British Columbia designate the printing trades for apprenticeship. The Apprenticeship Commission of the printing industry of the Montreal area, which represents both employers and unions, controls apprenticeship for that area.

Training programs in union shops are regulated by unions, in agreement with employers, and vary considerably according to craft and locality. In general, the apprenticeship is: compositors, electrotypers, stereotypers and photo-engravers, 5 to 6 years; lithographers, 4 to 5 years; pressmen, 5 to 6 years; bookbinders, male, 4 to 6 years, and female, 2 to 3 years.

Apprenticeship training usually includes, in addition to practical work on the job, classroom and correspondence work in related technical and other subjects. In areas where school facilities are not available, the greater part of the training is usually taken

(Photo: Provincial Publicity Bureau of Quebec, Ciné-Photography Service)

Technical and trade schools in larger centres offer industrial courses in printing that provide useful preparation for apprenticeship. It is possible, however, to enter the trade as an apprentice without previous training.

in the printing plant. In the Montreal area, in-plant training is complemented by technical instruction given at *l'Institut des arts graphiques* in Montreal.

Because of the continual changes that take place in printing methods and processes, journeymen frequently take further courses to bring themselves up to date. Such training is of particular value to those who wish to become specialists, foremen, supervisors or salesmen.

The ratio of apprentices to journeymen is quite rigidly controlled in the printing trades. It is therefore advisable for the would-be apprentice to get in touch with the appropriate union local and the owners of printing establishments. In this way, he can learn not only what the possibilities for apprenticeship are, but also the specific requirements. Guidance teachers and officers at National Employment Service local offices can help an applicant make these contacts.

WORKING CONDITIONS

The printing trades are, in general, strongly organized, which benefits the workers not only in terms of wages and paid vacations, but also in security of tenure. The major printing unions are known for welfare provisions which include pensions, hospitalization and educational programs.

With some exceptions, the printing trades offer interesting work, especially in the skilled occupations. The steady development of new methods and processes adds interest to the work, and encourages further study.

Generally speaking, employment is steady and the standards of pay are good. The printing trades are affected only moderately by seasonal fluctuations and are not as hard hit as many other trades in times of economic depression. There are a variety of highly

An enterprising journeyman may branch out by operating his own printing shop. He must be a good businessman and know the printing trade thoroughly.

(Photo: NFB)

skilled jobs that a worker can enter, given the opportunity, after reaching journeyman standing.

Often the worker is under pressure to meet a time limit. In the newspaper and magazine field, night work may be involved, but there is usually the incentive of higher wage rates or other compensation for such work.

On the whole, working conditions are good, but the composing and pressrooms are unavoidably noisy. The usual occupational hazards associated with machines exist for bindery, press and other workers, and there is a slight risk of lead poisoning for machine compositors. These dangers can, however, be avoided with proper care. The accident rate is comparatively low.

Wage Rates

The following tables give average hourly wage rates for selected trades in various localities. The ranges shown constitute the middle 80 per cent of rates reported. Wage rates for apprentices are based on a percentage of journeymen rates. Pay scales frequently change, are subject to geographical differences and vary with the degree of responsibility. The reader should refer to the National Employment Service, local employers, union officials, and government publications such as Wage Rates, Salaries and Hours of Labour in Canada, *Department of Labour, Canada, for current rates in a particular area or company.*

Average Hourly Rates in the Daily Newspaper Industry, October 1962

Locality	Standard Hours per Week[1]	Average Wage Rate per Hour (time work)	
		Compositor, Hand, and Linotype	Pressman
		$	$
Newfoundland —			
St. John's	40	1.92	1.95
Nova Scotia —			
Halifax	37½	2.88	2.88
New Brunswick —			
Saint John	40	2.19	2.19
Quebec —			
Montreal	35-37½	3.63	3.66
Quebec	37½-40	2.42	2.31
Trois-Rivières	37½	2.25	2.37
Ontario —			
Hamilton	40	3.18	3.03
London	37½	3.09	3.09
Ottawa	37½-39	3.17	3.10
Toronto	36¼	3.82	3.88
Windsor	37½	3.13	3.13
Manitoba —			
Winnipeg	40	2.63	2.57
Saskatchewan —			
Regina	40	2.30	2.30
Saskatoon	40	2.37	2.37
Alberta —			
Calgary	—	2.66	2.66
Edmonton	37½	2.70	2.70
British Columbia —			
Vancouver	37½	3.36	3.40
Victoria	37½	3.10	3.10

[1] Standard hours for employees in the composing and press rooms.

Source: Department of Labour, Annual Report on *Wage Rates, Salaries and Hours of Labour*, 1962.

Average Hourly Wage Rates in Printing and Publishing other than Daily Newspapers, October 1962

	Hours	Compositor, Hand		Linotype Operator		Pressman, Offset		Pressman, Cylinder		Pressman, Platen		Bindery Girl, Hand	
		Average	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range
		$	$	$	$	$	$	$	$	$	$	$	$
Newfoundland —													
St. John's........	40.7	1.65	—	—	—	—	—	1.65	—	1.65	—	.72	.58—1.01
Nova Scotia —													
Halifax...........	39.8	1.89	1.63—2.00	1.70	—	2.02	—	1.74	—	—	—	.85	.75— .88
New Brunswick —													
Saint John........	40.0	2.01	—	—	—	—	—	2.05	—	—	—	.80	.75— .83
Quebec —													
Montreal.........	38.3	2.73	2.25—3.04	2.77	2.38—3.13	3.00	2.20—3.71	2.59	2.25—2.82	2.42	2.00—2.70	1.32	1.13—1.46
Quebec...........	40.0	2.18	2.11—2.33	2.21	2.12—2.42	2.20	2.09—2.24	2.19	2.09—2.43	2.17	—	1.25	1.05—1.34
Ontario —													
Hamilton.........	38.2	2.54	2.20—2.76	—	—	3.24	2.64—3.91	2.58	2.40—2.66	2.24	—	1.44	1.25—1.58
London..........	40.0	2.45	2.30—2.56	2.51	—	3.29	2.62—3.76	2.24	2.18—2.35	2.22	2.20—2.27	1.09	.89—1.19
Ottawa...........	38.3	2.53	2.00—2.72	2.57	2.54—2.77	2.70	1.75—3.52	2.54	2.00—2.80	2.24	1.80—2.65	1.20	.85—1.47
Toronto..........	38.1	2.98	2.87—3.10	3.00	2.91—3.19	3.12	2.47—3.96	2.72	2.46—2.86	2.59	2.21—2.78	1.41	1.05—1.54
Windsor..........	38.5	2.70	—	—	—	3.01	2.74—3.42	2.66	—	2.68	—	1.48	1.42—1.51
Manitoba —													
Winnipeg.........	39.2	2.53	2.48—2.67	2.43	1.90—2.66	2.64	2.40—3.12	2.43	2.24—2.59	2.38	2.24—2.53	1.32	1.12—1.45
Saskatchewan —													
Regina...........	37.5	2.69	2.65—2.94	2.67	2.65—2.73	2.68	—	2.63	—	2.53	—	1.56	1.49—1.65
Alberta —													
Calgary..........	40.0	2.44	2.35—2.65	2.52	2.40—2.65	2.61	2.40—3.12	2.50	2.40—2.75	2.43	—	1.51	1.35—1.65
Edmonton........	40.0	2.49	2.45—2.58	2.51	2.45—2.60	2.72	2.45—3.15	2.48	2.45—2.60	2.28	—	1.57	1.54—1.67
British Columbia —													
Vancouver........	37.6	3.08	3.00—3.18	3.15	3.00—3.23	3.16	2.78—3.69	3.00	2.91—3.14	2.84	2.59—3.14	1.77	1.75—1.80

Source: Department of Labour Annual Report on *Wage Rates, Salaries and Hours of Labour*, 1962.

ADVANCEMENT

The usual ladder of advancement is apprentice to journeyman to foreman to plant superintendent.

Although the tendency is for tradesmen to remain in the trade for which they are trained, men in the composing room, with a creative flair, may become designers and layout men in the advertising field. The man who has leadership ability and who has a thorough knowledge of his department may advance to foreman. A foreman possessing supervisory and managerial qualities, who is well versed in the mechanics of the presses used in all departments, is acquainted with engraving processes, and has some knowledge of pricing policies and other pertinent details, may become a plant superintendent.

Firms, such as printing machinery houses, paper companies, and ink manufacturers, sometimes prefer to employ skilled craftsmen as salesmen, or perhaps as technical men, since they are better able to cope with the problems of customers.

A good number of tradesmen have assumed the management of smaller newspapers or become proprietors of small job-printing shops.

ORGANIZATIONS

The printing trades are highly organized in Canada, especially in urban centres. As a result, wages, working conditions and hiring policies are strongly influenced by unions. Of the 194 local unions in the printing and lithographic trades in Canada in 1962 with a total membership of 29,000, all but 22 are locals of international unions. Six of these: the International Brotherhood of Bookbinders (CLC); the International Photo Engravers' Union of North America (CLC); the International Printing Pressmen and Assistants' of North America (CLC); the International Stereotypers' and Electrotypers' Union of North America (CLC); the International Typographical Union (CLC); and the Amalgamated Lithographers of America (Ind.) have a membership of approximately 24,000.

The Printing Federation, a national union affiliated with the Confederation of National Trade Unions, and operating mainly

in the province of Quebec, has a total membership of about 5,100 distributed among 22 locals.

For complete details of organizations in the printing trades, the reader is referred to the annual publication *Labour Organizations in Canada* prepared by the Department of Labour. This contains statistics on union membership, a listing of the national and international unions operating in Canada in all branches of industrial activity, as well as the number of locals and their principal officers and publications.

DISTRIBUTION OF WORKERS

Geographic Distribution

The heavy concentration of printing employees in the central provinces is evident from the following table. More than three-quarters of the gainfully occupied were employed in Quebec and Ontario in 1961.

As is to be expected, most printing tradesmen are in the larger urban centres. The two cities of Toronto and Montreal bulk large in this employment picture. Together they employ 41 per cent of all compositors and typesetters, 52 per cent of all bookbinders, 62 per cent of all photo-engravers and lithographers, and 53 per cent of all pressmen and plate printers.

Percentage Distribution of Printing Tradesmen, by Selected Metropolitan Areas, 1961

	Montreal	Toronto	Vancouver	Winnipeg	12 Metropolitan Centres
Bookbinders	23.1	29.2	4.2	3.8	79.0
Compositors & typesetters	17.8	23.3	4.7	4.5	66.7
Photo-engravers & lithographers	23.3	39.4	5.4	2.7	86.3
Pressmen & plate printers	23.6	28.9	4.1	4.3	75.7
Other bookbinding occupations	11.1	34.9	4.3	7.8	76.0
Other printing & publishing occupations	21.8	35.0	3.4	3.1	81.6

Source: *1961 Census.*

Distribution of Printers, Bookbinders and Related Workers by Occupation, Sex and Region, 1961

	Maritimes		Quebec		Ontario		Prairie Provinces		B.C.		Total No. in Canada	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Compositors & typesetters......	808	108	4,372	303	7,057	376	1,903	151	1,173	65	15,313	1,003
Pressman, printing.............	274	16	2,707	208	4,098	217	790	41	485	27	8,354	509
Lithographic & photo-offset occupations..............	33	2	798	30	1,707	78	176	14	212	9	2,926	133
Photo-engravers..............	27	3	338	6	670	17	63	4	34	1	1,132	31
Bookbinders..................	29	93	471	982	665	1,119	115	270	83	151	1,363	2,615
Other bookbinding occupations..............	15	45	202	139	268	853	44	211	20	114	549	1,362
Other printing occupations......	56	12	566	221	1,025	518	144	28	121	7	1,912	786
Total................	1,242	279	9,454	1,889	15,490	3,178	3,235	719	2,128	374	31,549	6,439
Total (Combined)......	1,521		11,343		18,668		3,954		2,502		37,988	

Source: *1961 Census of Canada.*

Industrial Distribution

Most printing workers are employed in the printing and publishing industry but some are to be found in a number of other industries, such as paper products manufacturing, textiles, and trade and service industries, as well as in government service.

Percentage Distribution of Printing Tradesmen, by Selected Industries, 1961

	Printing & Publishing	Paper Products Mfg.	Trade	Public Admin. & Defence
Compositors & typesetters	84.7	2.5	1.9	3.0
Photo-engravers & lithographers	84.5	4.0	1.4	2.3
Pressmen & plate printers	82.6	6.6	1.5	2.2
Bookbinders	83.7	2.0	2.0	4.6

Source: *1961 Census.*

TRENDS

Employment in the printing industry has shown a small but steady increase over the past ten years. Data compiled by the Dominion Bureau of Statistics on the basis of establishments covered show that between 1950 and 1960 employment in the industry rose by 18 per cent to a total of 69,000.

The above figures cover all categories in the printing industry. The number of skilled and semi-skilled tradesmen in the industry are shown in the following table and their rate of growth can be traced by comparing the census figures for 1941, 1951 and 1961.

Printers are the largest group of tradesmen in the industry; in 1961, they made up 66 per cent and had increased by 21 per cent in the last ten years. Lithographers have also increased in number since 1951, reflecting the growing use of lithographic processes (a

Skilled and Semi-skilled Workers in Printing, Publishing and Bookbinding

	1941	1951	1961
All tradesmen	23,324	32,978	37,988
Male	20,062	27,010	31,549
Female	3,262	5,968	6,439
Engravers, lithographers and photo-engravers			
Male	2,007	3,523	—
Female	61	178	—
Lithographic and photo-offset occupations	—	—	3,059
Male	—	—	2,926
Female	—	—	133
Photo-engravers	—	—	1,163
Male	—	—	1,132
Female	—	—	31
Printers	17,232	20,841	25,179
Male	16,399	19,661	23,667
Female	833	1,180	1,512
Compositors and typesetters	—	15,253	16,316
Male	—	14,521	15,313
Female	—	732	1,003
Pressmen and plate printers	—	5,588	—
Pressmen, printing	—	—	8,963
Male	—	5,140	8,354
Female	—	448	509
Bookbinders	—	3,219	3,978
Male	—	1,050	1,363
Female	—	2,169	2,615

Source: *1951 Census: 1961 Census.*

percentage increase not shown due to different methods of occupational reporting). Bookbinders showed an increase of 23 per cent in the same period and in 1961 approximately 10 per cent of the tradesmen in the industry were in this group.

Although the number of women employed as either printers or in the lithographic group is relatively small, the percentage increase between 1951 and 1961 is proportional to men both in these occupations and for the skilled and semi-skilled occupations as a whole.

Employment Prospects

The long-term trend in the employment of most printing tradesmen has been steadily upward and it is likely that this trend will continue for some time to come.

Mention has been made of the high proportion of tradesmen in the central provinces and in the larger cities. Because of this, openings should be more plentiful and of greater variety in these areas than elsewhere, particularly for photo-engravers, lithographers and bookbinders. The concentration of compositors and typesetters in the larger cities is not as marked, and many small-town printing shops that publish weeklies and do job work offer these tradesmen opportunities for employment. It can be expected, of course, that competition for jobs in the printing trades will be keenest in the large cities.

The majority of printing tradeswomen are employed in bookbinding occupations; relatively few in the other trades.

Approximately two-thirds of all printing tradesmen are to be found in the printers' group of occupations (compositors and pressmen). The likelihood is that the greatest number of opportunities will be in machine composing and press work. Monotype keyboard operation, monotype casting, electrotyping and stereotyping are expanding fields, but the number of openings that may occur here will be considerably fewer than for linotype operators and pressmen.

Expansion should also occur in the photo-engraving and lithographic fields. Increasing use of illustrations and colour should benefit the lithographic trades and provide a demand for lithographers, pressmen, and other tradesmen skilled in colour work.

One of the biggest developments of recent years has been the remarkable growth of offset printing. This kind of printing is now in keen competition with the regular letterpress on many types of work. It also appears probable that offset work will increase, which will mean a demand for more workers trained in offset methods.

Bookbinding has, in the process of mechanization, become an occupation needing a smaller proportion of fully skilled workers. The trade is dependent upon the demand for books and is directly affected by economic conditions. The long-term trend for all-round bookbinders will probably continue downward.

Seasonal unemployment is not very common in the printing trades, the number of workers employed throughout the year being quite constant. Adverse economic conditions affect certain types of printing more than others, less so in the newspaper field and more so in the job printing field. A high level of business makes for a high demand for printed products and advertising materials; consequently, printing tradesmen who are employed in establishments dependent on this demand are more affected by a low business level.

Technological Change

Some consideration must be given to the probable effects of technological changes on opportunities for printing tradesmen. The introduction of the composing machine has resulted in fewer jobs for hand compositors. Advances in presses have changed the character of the pressmen's work. There has been rapid improvement in the offset printing process, both in reproduction and in presses.

The demand for machine compositors in the newspaper field has been affected to some extent by the introduction of the teletypesetter. Most of the typesetting required by a newspaper is still, however, done by linotype and monotype operators. The teletypesetter can transmit copy to a number of newspapers in the form of perforated tape which, when fed through an attachment on a linotype machine, causes type to be set automatically. This machine is mainly used by newsgathering agencies, such as the Canadian Press, to service its member newspapers.

Most shops are using the printing methods and equipment previously described. In some shops, however, photo-typesetting machines and new makeup methods are supplanting conventional

metal type methods. It is likely that these new machines will come into wider use as time goes on.

Where photo-typesetting machines are used, layout is done on a master form, indicating where borders, lines, illustrations, display type or other type material are to be placed. In paste makeup the workman places film or paper in position on the master form, as he would type or cuts in the metal types process. The completed master is checked, proofread, then photographed, and a printing plate made.

Some of the new photo-typesetting machines have the same function as the linotype, intertype and monotype machines — to produce type material by keyboard operation. Instead of casting metal slugs, however, these new machines have built-in cameras that produce type material set up line by line on a roll of photographic film, which is developed in the darkroom.

Most of the lines of large display type are composed on photo-lettering machines. The type material is in the form of strips which, depending on the type of machine used, may be developed in the darkroom or in the machine itself.

Although radically different from conventional metal type methods, the new processes still require a thorough understanding of the graphic arts. In shops where these changes are being made, journeymen are being trained in the new methods, as are apprentices after they have received basic training in the metal type methods.

Technological change has, in the past, gradually altered the character of the printing trades and will continue to do so in the future. The established trades, and those that have come into being recently, offer good opportunities in a steadily expanding printing industry, an industry which plays a vital role in the lives of Canadians.

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LOCAL INFORMATION

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PRINTING TRADES
Monograph No. 9

CANADIAN OCCUPATIONS

★

MOTOR VEHICLE MECHANIC and REPAIRMAN

★

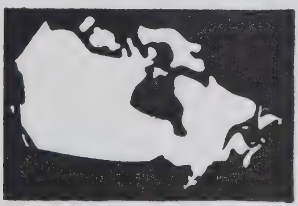
MONOGRAPH 10

DEPARTMENT OF LABOUR, OTTAWA

CANADIAN OCCUPATIONS

★

MOTOR VEHICLE MECHANIC and REPAIRMAN



MONOGRAPH 10

HON. MILTON F. GREGG, V.C., MINISTER
ARTHUR MacNAMARA, C.M.G., LL.D., DEPUTY MINISTER

DEPARTMENT OF LABOUR, OTTAWA

FOREWORD

During recent years there has been a steadily increasing demand for up-to-date information on occupations.

This demand comes from youth faced with the need of choosing an occupation and of selecting the type of training required; from parents, teachers and other counsellors; from workers shifting to other occupations; from employment service officers; from directors of personnel and union officials, and from other quarters.

This series of monographs and an accompanying series of pamphlets, the latter containing similar information in a condensed form, are attempts to meet this demand.

These publications represent an expansion of an earlier series issued by the Department of Veterans Affairs to assist members of the armed forces returning to civilian life following the end of the war. These current series, designed for general use, cover a wide range of occupations, including professions. They indicate, among other things, the nature of the occupation or group of occupations, entrance and training requirements, working conditions and opportunities in each.

The monographs have been prepared by our research staff working on occupations, with the generous help and advice of officials of the Unemployment Insurance Commission, Vocational Training Branch and Bureau of Technical Personnel of the Department of Labour, Dominion Bureau of Statistics, Provincial Departments of Education and of Labour, employers' associations, trade unions, professional associations, and other government and non-government bodies.

Grateful acknowledgment is made of this assistance and that obtained from numerous publications on occupations prepared in Canada and in other countries.

DIRECTOR,
Economics and Research Branch,
Department of Labour.

September, 1950.

MOTOR VEHICLE MECHANIC AND REPAIRMAN

HISTORY AND IMPORTANCE

In the latter half of the 18th century inventors in both England and France began to experiment with the steam engine as a mode of propulsion for road vehicles. This development was a logical result of the building of good highways in both countries, and of the desire for greater speed and power in traffic. At the beginning of the 19th century, and for some decades after, some passenger steam coaches were operating in competition with the horse-drawn stage coaches in Britain; the pre-

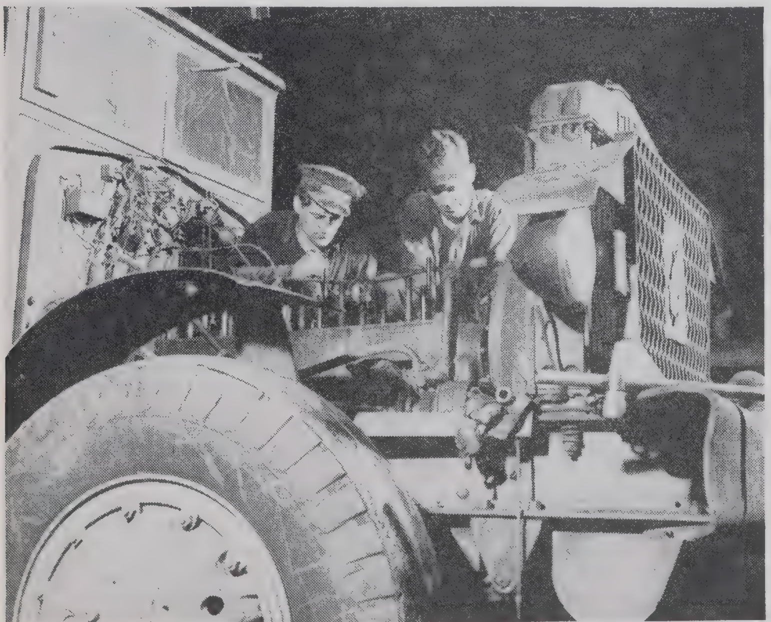


Photo N.F.B.

Adjusting a diesel engine

ponderance of horse traffic over mechanized traffic and the advent of railways, however, led to political pressure which resulted in the "Red Flag Act" of 1831, limiting the speed of power-propelled vehicles on the roads by requiring a red flag to be carried in front by day, and a red lantern by night. The only steam vehicles which could operate under those conditions were the heavy "traction engines" belonging to contractors, municipal councils, and a few large-scale farmers.

Meantime a new type of engine was being planned, and in 1885 Daimler patented in France the first internal-combustion engine using the group of hydro-carbons now known as gasoline (in England "petrol"). Nine years previously Otto had developed and exhibited in Paris an internal combustion engine using illuminating gas. Daimler, Benz, Panhard, Peugeot, and De Dion were all inventors who produced motor carriages in France in the 1880's. British and American engineers were working on similar developments by 1890; the Americans were somewhat obsessed at this time by the possibilities of steam cars, and were handicapped by the lack of good highways. Ford and Duryea produced cars which would run, in 1892 and 1893, but a stimulus was needed to the full development of the motor vehicle. In Britain the Red Flag Act, and in the United States lack of good roads, were holding back practicable testing and general use of this new means of transport.

In 1896 the Red Flag Act was repealed, and schoolboys along the route from London to Brighton had a half-holiday to see over fifty cars and motor cycles attempting the hilly run on the 52-mile highway between those points. The cars were representative of all countries already in the field, and it is a tribute to the good workmanship put into these early vehicles that those of them surviving have gone over the course each year since, except during the wars, on the anniversary of the original run. A French Panhard car, in the same year, eclipsed all records by a run of over 1,000 miles. It is probable that the very great use of the bicycle in Britain and France in the early "90's" was the factor which led to the repeal of the Red Flag Act, and it should be noted that had the pneumatic tire not

been invented for the bicycle, together with the ball-bearing hubs, the development of the motor car might have been much delayed.

In 1900 motor buses were already running in London, and inventors in all industrialized countries were working on improvements in cars, some of which developed into the now familiar gear-shifts, drive-shafts, differentials, ignition systems, steering gear, lighting systems, and the countless details, useful or ornamental, which enter into the modern car's composition.

The United States very shortly caught up with European progress, and before long was producing more cars, under a greater variety of names, than any other country. Litigation on basic patents acted as a drag on progress in all countries, but once this was settled, in 1911, it was possible for such makers as Henry Ford to produce in quantity, on an assembly-line basis, vehicles which previously had been largely custom jobs individually built. The great improvements in the highway systems of most of the United States resulted in the popular demand for a low-priced car, and this was met by Ford and his competitors.

The amalgamation of most of the American manufacturing firms in the industry into three groups has simplified the production and distribution of cars, not only in North America but over most of the world. The development of the truck, the trailer truck, the long-distance bus and the city bus, and the farm tractor, the bulldozer, and other mechanized large-scale power tools was a logical sequence of events.

In 1907 Canada had 2,000 registered motor vehicles; in 1920 the number was 400,000, and in 1947 about 1,800,000, or one for every six persons in the population.

It was early very obvious that the average person owning or operating one of these new inventions was quite unlikely to be able to make necessary adjustments and repairs, as many found out to their sorrow. The popular humour of the early 1900's was well seasoned with jokes on the unfortunate motorist, usually depicted underneath the car in a sea of mud. Such a situation did

not last long, since the machinist, cycle mechanic, locomotive mechanic, and electrician of the period saw in many cases an opportunity to make for himself a new field of a much more profitable nature. Possibly the bicycle mechanic predominated among the early recruits to attempt repairing, and it must be remembered that the factories turning out custom-built cars were taking in apprentices and training mechanics who had a unique opportunity to strike out for themselves as soon as they knew their jobs, which at that time were largely skilled. For a long time the men in the factory exceeded in numbers those who adjusted and repaired the factory products as individual technicians. As cars became more complex, their parts became more delicate and inaccessible, and the interiors and supplementary fittings became more luxurious. The number of vehicles on the roads increased enormously in proportion to road and parking space; accidents increased in number. Demand for mechanics and repairmen grew by leaps and bounds. The estimated 17,000 separate enterprises which service cars, trucks, buses and farm machinery in Canada now employ more people in this service work than are engaged in the manufacture of cars in our country.

The announcement, early in 1950, of the successful trials of a jet-turbine car, using kerosene, in England, may portend a revolution in the automotive world, since the mechanism of this type eliminates many features of the piston-engine driven vehicle. Thus the mechanic and repairman may find it necessary to learn new techniques in the coming years.

FIELD AND NATURE OF WORK

General Definition

Motor vehicle mechanics are skilled workers who adjust, repair or replace worn or damaged mechanical, electrical and body parts of passenger cars, trucks, buses, motorcycles, tractors and other internal-combustion powered vehicles. For the purposes of this monograph, the term "automobile mechanic" will be used synonym-

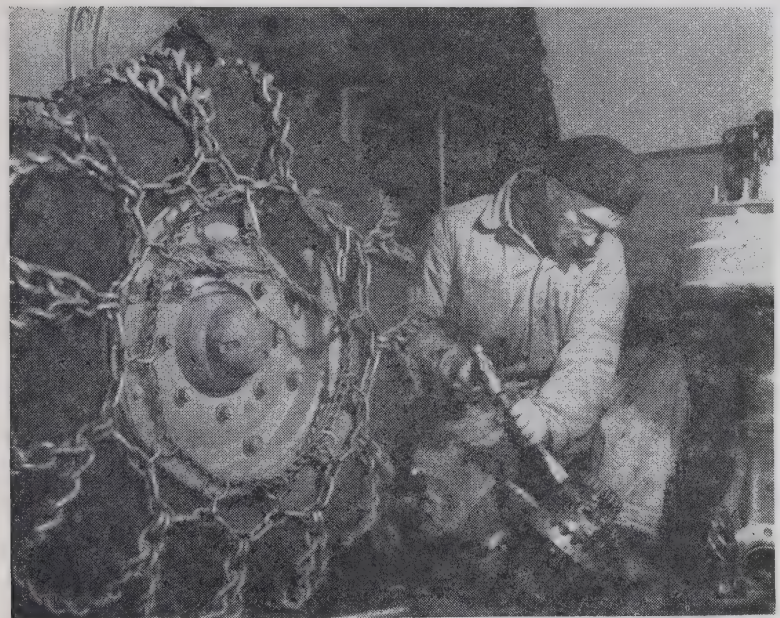


Photo N.F.B.

Working on a crown pinion

ously with that of "motor vehicle mechanic" or "motor mechanic".

There are three main groups of motor vehicle mechanics: *general automobile mechanics*, who are fully skilled in general repair work; *specialists*, who are also fully skilled in general repair work but who specialize in one or more aspects of the work—e.g. automobile electrician, brake repairman, wheel alignment mechanic, motor or engine automobile mechanic; and the *"single-skill" mechanic*, who has little knowledge of general repair work, but has learned one particular job.

Although a fender and body mechanic is a motor vehicle mechanic, he does not require a knowledge of the principles of the internal-combustion engine, nor is he concerned with the other mechanical or electrical parts

of the motor vehicle. His work is separate from that of the general automobile mechanic and consists mainly of repairs to fenders, door panels and roof tops, and calls for skill in metal work, welding and painting.

It is well at this point to distinguish between the automobile mechanic and the automobile machinist. The latter is not covered in this study. The automobile machinist is a skilled machinist who, working in a machine shop or factory (sometimes in a garage), uses a variety of special or general metalworking machines, such as lathes, piston-grinding-and-turning machines, valve-grinding machines, in the process of making, or doing major repairs to, automobile engines and other mechanical parts. The automobile mechanic, on the other hand, is largely concerned with the replacement rather than the actual repair (especially major repair), of damaged parts or defective motors. This has come about because of the availability of mass-produced component parts and the practice of replacing defective motors with motors rebuilt in a machine shop or factory by a machinist.

Automobile mechanics may also work on diesel-powered motor vehicles. Such mechanics require additional training in the principles of the diesel engine, its maintenance and repair.

Farm vehicles, especially tractors, and other earth-moving equipment, such as bulldozers, which may be either gasoline or diesel-powered, are also repaired by motor vehicle mechanics.

The automobile upholsterer does not come within the classification of automobile mechanic. As a rule, difficult upholstery or trimming work is done by a regular upholstering establishment, simpler work by the body and fender man.

Field of Work

The majority of motor vehicle mechanics are employed in general repair garages, in the service departments of automobile and truck dealers, and in specialty

garages. In the large dealer shops and in some independent repair garages, where the work is departmentalized, it is customary for mechanics to specialize. Men employed in such shops may, however, be shifted from one department to another, depending on the extent and kind of work on hand, so that the mechanic's duties may be more varied in such establishments than in specialty garages. Specialty garages usually concentrate upon one particular service, such as motor repair, brake service and wheel alignment, carburetor and ignition repair, body and fender repair, and radiator repair. Mechanics in such shops are either specialists or single-skill workers.

Many large firms in the commercial, manufacturing and transportation fields operate their own garages in

Photo N.F.B.

Tightening headbolts on engine

order to service fleets of company passenger cars, trucks and other motor vehicles. Examples of these are department stores, food distributors, delivery concerns, construction establishments, bus companies, taxi companies, etc. Governments—federal, provincial and especially municipal — also operate garages for all types of publicly-owned motor vehicles.

There are many types of internal-combustion engines in the petroleum exploration, pipe-line construction, and oil transportation fields which call for the services of skilled automotive mechanics.

A small number of skilled mechanics are employed by gasoline stations. Some of these gasoline station garages do either general or specialized repairs (usually on passenger cars and light trucks), but many do only minor adjustments and repairs, so that the need for the skilled mechanic in this field is not great.

Automobile mechanics are also employed, to a small extent, by automobile and truck manufacturing concerns, where they repair or replace defective motors and parts.

Other lesser fields for the mechanic are provided by automobile wreckers, who buy old or damaged motor vehicles and repair them for resale or dismantle them to sell the parts, and by used-car dealers, who recondition cars and trucks for resale.

Duties[1]

In the following outline of duties, the three main groups of mechanics are dealt with:

General Automotive Mechanic

Determines and diagnoses either by personal inspection, questioning driver, or by use of special instruments and mechanical devices, the location of faulty operation;

[1] Description of *Duties* adapted (with certain changes) from *Automobile and Truck Mechanics* in the "Occupational Guide" series issued by the Michigan State Employment Service Division, Detroit, Michigan.

disassembles separate parts of the vehicle, such as motor, transmission, clutch, differential, steering mechanism and electrical system, using necessary hand tools and specialized equipment; repairs or replaces worn or damaged parts; reassembles the parts in correct arrangement, making necessary adjustments for alignment or clearance; and performs other related repair tasks to place vehicle in operative condition.

The duties of the general automobile mechanic vary according to the type of motor vehicle usually serviced in a particular establishment. For example, he may work on automobiles and light trucks, heavy trucks, buses, and other vehicles both gasoline and diesel-powered.

In addition to the duties already mentioned, the heavy-truck mechanic maintains and repairs air and hydraulic couplings, and other connective mechanisms; air, electric and hydraulic brake systems; auxiliary mechanisms including winches, pumps, dumping or lifting apparatus, refrigerating equipment, trailers and trailer equipment, etc.

The bus mechanic performs repair and maintenance work on all types of heavy-duty passenger buses.

The diesel-engine automobile mechanic performs repair and overhaul work similar to that of the general automotive mechanic, on trucks, buses, etc., which are equipped with diesel engines. In addition, he repairs and maintains fuel injection systems, fuel or spray nozzles, fuel-transfer or oil-supply pump and governor, and times the fuel injection pump.

An automotive mechanic who works in the petroleum exploration, pipe-line construction and oil transportation fields diagnoses and repairs mechanical defects in ditch-digging machines, pipe-laying machines, and back-fillers. Replaces or repairs broken and worn parts of pumps, air compressors, and other related equipment. Disassembles and overhauls drilling engines, gas engines, small lighting plants, bailing machines, or other automotive engines. Repairs and maintains automobiles, trucks, and tractors. May give instructions in operation and care of equipment.

Specialty Automotive Mechanics

As mentioned previously, these workers are usually general automotive mechanics who have specialized in one particular phase of repair. They are usually employed in departmentalized or specialty garages, and at slack periods may be shifted from one phase of the work to another. Some of the specializations, with their particular duties, are as follows:

Automobile Electrician—repairs and installs ignition systems, starters, coils, generators, condensers, distributors, panel instruments, and other electrical equipment on various types of motor vehicles, using necessary hand tools and mechanical and electrical testing devices. May do motor tune-up, and, if qualified, may test, repair and install automobile radio receivers and aerials.

Brake Repairman—tests, overhauls, and adjusts mechanical, electrical, air and hydraulic brake systems on various types of motor vehicles. Usually operates a brake-drum lathe to re-surface scored brake drums. May repair and install shock absorbers and leaf or coil springs.

Wheel Alignment Mechanic—tests for and corrects alignment of automobile, truck, bus and tractor frames, wheels, steering-gear and front axle assembly, using necessary hand tools and mechanical testing or corrective devices. May weld, bend, or otherwise straighten axles, and repair or install shock absorbers and springs.

Automobile Mechanic, Motor—repairs and installs motors in all types of motor vehicles. May work entirely at a bench, doing inspection and adjustment of motors.

Automobile Radiator Man—tests, cleans and repairs automobile, truck, bus and tractor radiators, pumps and other parts of cooling system. Work usually involves testing radiator, motor block, hoses, and pumps for leaks; checking, repairing or installing hoses, thermostats and pumps; soldering radiator cores and cleaning entire cooling system.

Body and Fender Mechanic—repairs or replaces damaged fenders, door panels and roof tops: hammers out dents; smooths hammered area by filing or by grinding or sanding it with small electric grinding or sanding wheel. May fill badly dented areas with solder if hammering and filing does not remove dents, and file solder until area is smooth and blends with adjacent surface. May weld breaks in body metal and file weld smooth. Prepares the surface properly for painting. May paint damaged part or whole vehicle using a spray gun.

Although the automobile radiator man and the body and fender mechanic are considered to be specialists, they are not usually all-round mechanics.

Photo N.F.B.

Welding rear of car

Single-Skill Automobile Mechanics

Most of these workers do not have the all-round knowledge of the general automotive mechanic and have been trained in only one aspect of the work. It will be noted from the following list of single-skill occupations that the work is even more differentiated than in the case of the specialist, each part being done by a single-skill mechanic:

Brake Repairman: Brake-Drum-Lathe Operator; Brake Adjuster; Air Brakeman; Hydraulic Brakeman.

Automobile-Fuel Pump Repairman

Automobile Generator Repairman

Automobile Starter Repairman

Carburetor Man

Shock-Absorber Repairman

Automobile Radio Repairman

Motor Adjuster

QUALIFICATIONS

The normal entrance age for apprenticeship to this trade varies from 16 to about 21. In British Columbia, apprenticeship regulations stipulate 15 as the minimum entrance age; in Manitoba, the maximum age is set at 22, although older applicants may be approved. No maximum age is set in the case of Nova Scotia, New Brunswick, Quebec, Saskatchewan and British Columbia.

The academic requirements called for by apprenticeship regulations are not high. In four provinces—Nova Scotia, Saskatchewan, Alberta and British Columbia—there is no definite minimum educational requirement. In Quebec, the minimum is Grade 6; in Ontario, Grade 8; and in New Brunswick and Manitoba, Grade 9. Apprentice body repair mechanics in New Brunswick are accepted with Grade 8 standing; in the other provinces, the educational requirement is the same as for motor vehicle mechanics.

One interested in this trade would do well to get as much secondary school training as possible, preferably at a technical or vocational school offering a course in motor vehicle repair work. The practical experience and the theoretical knowledge gained from such a course, not only in motor mechanics, but in such general subjects as mathematics, chemistry and physics, provide a valuable pre-apprenticeship training. The student who completes such a course, or who has taken a good part of it, will be more readily accepted as an apprentice than one who has not had any preliminary training. Another advantage of pre-apprenticeship training is that a time-credit is usually allowed for such training and the term of apprenticeship correspondingly shortened.

One considering this trade should have an aptitude for, and an active interest in, working with his hands and with mechanical things. Attention to small details, neatness, perseverance, trustworthiness, and courtesy are other desirable personal qualities. A pleasing personality, and the ability to deal with the public and workmen, are important qualifications for the mechanic who aspires to the position of service manager.

Because of the physical movements involved in the occupation—a great deal of standing, reaching, lifting, carrying, pushing, pulling, handling and fingering; a moderate amount of walking, turning, stooping, crouching, kneeling and sitting; and a small amount of balancing and climbing—the motor vehicle mechanic should be physically strong, be agile, have good health and endurance, fairly good eyesight (with or without correction), and fairly good hearing. The occupation also calls for strong legs and arms and a fair degree of dexterity in hand and finger movement. Some employers require that workers pass a physical examination before they are hired.

The trade of motor vehicle mechanic does provide some opportunity for certain handicapped individuals. Workers with finger disabilities, blindness in one eye, poor hearing, flat feet or fallen arches, or malaria are not barred from employment. Poor eyesight, missing limbs

and pulmonary ailments are, however, definite handicaps in gaining employment. There are instances, not too common, of successful workers in this occupation who have the use of only one leg or have limited use of both legs.

TRAINING

In the early days of the automobile, and for some time afterwards, training in this trade was rather haphazard. The best mechanics were usually men who had served their time as a machinist and had applied their knowledge to the internal-combustion engine. Other motor mechanics acquired their skill by working on cars in a garage, either alone or as a helper.

A more systematic and broader training was necessitated when motor vehicles, over the past twenty years or so, became more varied, more advanced in design, and were made to finer tolerances; the development of complex testing equipment and tools, which made possible a greater refinement of adjustment, also added to the need for a more comprehensive system of training.

The majority of Canadian provinces, recognizing the need, have established systematic apprenticeship programmes for the training of motor vehicle mechanics. In addition, some provinces have established pre-apprenticeship courses.

Mention has been made of the desirability of a technical or vocational school course as preparatory training for apprenticeship. The same can be said for provincial pre-apprenticeship courses. Under an amendment to the Vocational Training Co-ordination Act, dated January 3rd, 1949, the federal government has offered to assist interested provinces in establishing pre-apprenticeship courses. The plan calls for a trainee to attend full-time classes at one of the provincial centres for a period of six months, receiving a weekly allowance during the training period. At the end of the course, trade tests are given and the trainee rated according to his standing.

At the present time, pre-apprenticeship courses for motor mechanics and repairmen are being conducted

in Nova Scotia, New Brunswick, Manitoba and Alberta. In the case of Alberta, a trainee must first become indentured as an apprentice before he is eligible for such a course. This is not required in the other three provinces.

One can become an all-round motor mechanic in one of two ways: either as a helper or as an apprentice. The latter means of training is the more desirable for several reasons: there is an agreement between the employer and the apprentice which provides for a progressive and thorough training; in the majority of provinces apprenticeship training is controlled by provincial Apprenticeship Boards (in Quebec, by local Apprenticeship Commissions); also, a wage rate, which is on a progressive scale, is laid down by the apprenticeship authorities. These factors do not apply in the case of the helper. Despite this, it is only fair to say that helpers do, in many instances, get an all-round training in the trade. Much depends on the employer.

There are two schools of thought on the subject of training for a specialized field in the trade. One school holds that training should be restricted to that specialized field; the other opinion is that a man should first become a fully-skilled general mechanic and then specialize. The latter argument has the greater merit for the reason that the all-round mechanic, with his broad training, can choose any one of a number of specializations if he so desires, or he can do general work—his field of employment is much broader than that of the mechanic who knows only his specialty, and he is better able to adjust to changes in the occupation.

In all provinces, with the exception of Prince Edward Island and Newfoundland, there is a planned programme of apprenticeship training provided by provincial law and administered by the various provincial Apprenticeship Boards or Committees. In the case of Quebec Province, the Quebec City area is the only one in which, at this date, this trade is designated for apprenticeship. The trainee in most provinces is indentured to a reliable employer for a specific period, during which time he must comply with certain rules and regulations. Under the same agreement, the employer is obliged to teach the

apprentice all phases of the trade, to keep him employed as long as there is work, and to submit periodic progress reports to the local Apprenticeship Committee. In the event that an employer is unable to give training in a certain field or if, for some reason, the firm is forced to close, the apprentice is placed with another employer, either temporarily or to finish his "time".

The training lasts for four years in some provinces, for five years in others, each year representing a specific number of work-hours. Many think this training period is unnecessarily prolonged. It is held by the trade, however, that the stipulated term does not represent the time required to learn the various operations but the period necessary for the apprentice to encounter the various jobs a number of times and to be able to do the work in a reasonable length of time.

The term of apprenticeship is reduced by experience in the field, training in related subjects in technical or vocational schools, or pre-apprenticeship courses.

The training of the apprentice covers: Practice—the skill in performing tasks, and Theory—the reason for certain practices. In the garage or shop, the apprentice is placed under the supervision of a journeyman motor mechanic. Starting with the simple tasks, he follows a progressive programme of work in accordance with a suggested schedule from the Apprenticeship Board. The major portion of the final year of training is taken up with becoming proficient in the work, and in learning something about business operation—keeping records, meeting the public, etc.

Theoretical instruction is taken concurrently with training on-the-job. In general, this instruction takes one of three forms: *Full-time classes* lasting from three to six months, during which time the apprentice, with the exception of those in Quebec Province, receives a weekly allowance paid by the provincial government; *Part-time classes* held in the evening, Saturday morning or during working hours (in many cases, the apprentice is paid at the prevailing rate by the employer); *Correspondence courses* for apprentices in rural areas.

The following shows the classroom and correspondence instruction schemes in effect in the various provinces, with the exception of Quebec:

Nova Scotia	—*Part-time,* 144 hours per annum; prevailing rate paid by employer.
	Correspondence.
New Brunswick	—*Full-time.*
	Part-time, 144 hours per annum; prevailing rate paid by employer.
	Correspondence.
Ontario	—*Full-time* for two months during the first two years of apprenticeship.
Manitoba	—*Full-time* for six weeks per annum.
	Correspondence.
Saskatchewan	—*Full-time,* from one to three months per annum.
	Correspondence for more advanced apprentices.
Alberta	—*Full-time,* from one to three months per annum.
British Columbia	—*Full-time.*
	Part-time, four hours per week. Some apprentices paid at the prevailing rate.
	Correspondence.

Many large companies which have a group of apprentices in training at the one time conduct their own apprenticeship schemes. The training pattern is much the same as that already outlined.

When an apprentice has passed his final tests, he receives his journeyman's papers, which show that he has served his time in the trade.

Some capital investment is necessary, as every mechanic must have his own tool kit. The amount invested will vary. A general mechanic may spend from $100 to $150 on his initial kit and then add to it as he is able. Employers frequently assist the apprentice in financing tool purchases.

For the automobile mechanic, training is a continuous process. The many innovations, models and methods in the field make it necessary for the worker to spend considerable time studying trade books or taking special courses. Some employers arrange for regular refresher courses for their employees.

The trend toward specialization and departmentalization has led many to improve their position by taking additional training in some particular field in the trade.

Single-skill mechanics do not serve an apprenticeship, as the length of time necessary to learn the occupation is relatively short. The learner works along with the trained worker on the job, and in this manner is soon able to carry out the single operation.

ENTRY INTO THE OCCUPATION

Many young men get a start in the trade through personal contacts or by working in a garage after school or during vacations. Also, the daily newspapers regularly carry advertisements for experienced motor mechanics, helpers and apprentices.

Apart from these self-placement methods, prospective trainees enter the occupation through organized channels. Many garage operators hire apprentices through the technical or vocational schools direct, or through the local provincial apprenticeship inspector. School authorities recommend students from the graduating class, provided the employer is found suitable by the local Apprenticeship Committee. Night school or special-class students may be recommended when, in the opinion of the instructors, they are ready for placement.

The National Employment Service, through its local offices, actively assists young men to enter the occupation.

The apprentice who has just attained journeyman status will, in many cases, stay on with his employer. If he wishes to make a change, the local office of the National Employment Service, his trade contacts, or newspaper advertisements will facilitate this.

EARNINGS

Wages paid to motor mechanics vary widely, influenced as they are by such factors as locality, type of garage, skill level of the worker, and the length of the work-week. Another factor which makes for differences is that mechanics are mainly paid in two ways—either on a flat-rate or piece-work basis or by the hour.

The flat-rate or piece-work scheme works in this way. The garage sets a definite time for the completion of each type of repair. For example, a certain repair job may be fixed at five hours. The customer is charged so much per hour (commonly $2.00 to $2.50 in urban areas, somewhat less in rural areas), the mechanic receiving 40 to 45 per cent of the hourly charge as his share. If the mechanic completes the job in less than five hours, he still gets paid for five hours' work. The repair times set by garages are liberal, so that a good mechanic usually completes a job well ahead of the time limit. Under this system, the mechanic must be accurate, as well as fast, since he is not paid for work that has to be redone. Higher rates for overtime are not common under the flat-rate scheme. However, it is possible for a good mechanic to earn anywhere from $50 to $80 a week under this system, given steady work. In some garages, workers are assured of a minimum weekly wage, this to take care of a temporary decrease in work.

The hourly rate system of pay is common to municipal and private transportation garages—bus, railway, taxi, trucking—farm machinery repair and small concerns. Workers are paid a fixed amount per hour, whether or not there is any work. Earnings under this system, however, may not be as high as under the flat-rate scheme in the case of experienced men. Time-and-a-half for overtime is paid in many cases.

The Apprenticeship Boards of the various provinces set the minimum wage rates for apprentices, calculated as a percentage of the prevailing rate paid the journeymen in the garage. In some provinces increases are granted every 6 months and in others every 12 months.

Pension schemes are another factor in earnings, although these are by no means general; a number of garages have set up contributory plans for their workers.

The table below gives the average hourly rates, the range of rates and standard hours per week for automobile mechanics in garages in various localities as at October, 1948, the latest date for which this information is available.

AVERAGE WAGE RATE PER HOUR, RANGE OF RATES PER HOUR, AND STANDARD HOURS PER WEEK FOR AUTOMOBILE MECHANICS IN GARAGES, OCTOBER 1948.

Occupation and Locality	Average Wage Rate per Hour	Range of Rates per Hour	Standard Hours per Week
Automobile Mechanics	$	$	
Canada	1.01	....	....
Nova Scotia	.88	....	....
Halifax	.84	.70– .95	45 – 50
Sydney	.97	.86–1.02	44 – 48
Truro	.78	.73– .88	53 – 54
New Brunswick	.85	....	....
Moncton	.87	.80– .98	49
Saint John	.84	.80– .88	50
Quebec	.96	....	....
Montreal	.96	.75–1.10	49 – 54
Quebec	.92	.83–1.00	49
Sherbrooke	.95	.80–1.00	49
Ontario	1.00	....	....
Brantford	1.00	.83–1.05	48 – 49
Belleville	.80	.70– .94	48
Cornwall	.95	.80–1.10	48 – 49
Fort William and Port Arthur	1.06	.90–1.15	48
Hamilton	.90	.80–1.01	48 – 50
Kingston	.91	.85–1.02	48 – 49

AVERAGE WAGE RATE PER HOUR, RANGE OF RATES PER HOUR, AND STANDARD HOURS PER WEEK FOR AUTOMOBILE MECHANICS IN GARAGES, OCTOBER 1948 — Continued.

Occupation and Locality	Average Wage Rate per Hour	Range of Rates per Hour	Standard Hours per Week
Automobile Mechanics	$	$	
Ontario—Continued.			
Kirkland Lake	.92	.80–1.00	48
Kitchener	.97	.95–1.00	45 – 49
London	1.02	.95–1.13	48
Niagara Falls	.94	.85–1.05	48
Oshawa	.99	.85–1.05	48
Ottawa	.92	.75–1.25	48 – 49
Peterborough	.88	.70–1.02	48 – 49
St. Catharines	1.04	.86–1.15	48 – 50
St. Thomas	.99	.90–1.04	48
Sudbury	.99	.90–1.01	48
Timmins	1.07	1.00–1.10	48
Toronto	1.05	.95–1.15	45 – 48
Welland	.88	.75– .95	48
Windsor	1.00	.75–1.12	47¾–48
Manitoba	.91	....	....
Winnipeg	.91	.70–1.06	46 – 50
Saskatchewan	.94	....	....
Moose Jaw	1.01	.90–1.06	48
Regina	.93	.80–1.00	44 – 48
Saskatoon	.91	.70–1.03	48
Alberta	1.08	....	....
Calgary	1.13	1.00–1.20	43½–46½
Edmonton	1.07	.95–1.20	46½
Lethbridge	.98	.95–1.00	44 – 48
Medicine Hat	.93	.85–1.00	48
British Columbia	1.15	....	....
Nanaimo	1.12	1.00–1.15	44
New Westminster	1.24	1.20–1.25	44
Prince Rupert	1.09	.80–1.25	44
Vancouver	1.20	1.00–1.30	44
Victoria	1.05	.90–1.10	44

Source: Department of Labour, Economics and Research Branch, *Annual Report on Wage Rates and Hours of Labour in Canada, October, 1948.*

WORKING CONDITIONS

Working conditions for motor mechanics vary according to the type of garage. On the one hand there is the modern, well planned establishment, which is well lighted, ventilated and heated, and has lunch-room, locker and washroom facilities. The flow of work is organized and facilitated by many time and labour-saving devices. On the other hand, there are still many shops which have poor lighting, heating and ventilation, and where the mechanic has to work in a cramped space and with fewer labour-saving devices. The increased floor space of large garages has eliminated much of the outdoor repair work on vehicles, but this is not possible in the case of many small firms.

ADVANCEMENT

The usual line of advancement for motor mechanics is from apprentice to journeyman, journeyman to foreman, and foreman to service manager or superintendent. Beyond the journeyman stage, advancement is necessarily slow because of the small number of supervisory positions.

Going into business on one's own is another possibility for the mechanic who has the experience, sufficient capital, and a good knowledge of business operation. How much capital is required depends entirely on the size and type of garage planned.

RELATED OCCUPATIONS

Occupations which are concerned with the assembly, repair and maintenance of internal-combustion engines are all closely related to that of the motor mechanic. Some of these are:

Aircraft-Engine Mechanic (air trans.)
Aircraft-Engine Assembler (air trans.)
Aircraft-Engine-Cylinder Mechanic (air trans.)
Engine-Service Mechanic (air trans.)

Engine Tester (air trans.; aircraft mfg.)
Diesel Mechanic (any ind.)
Motor and Chassis Inspector (auto mfg.)
Experimental Mechanic (auto mfg.)

Another closely related occupation is that of motor vehicle mechanic instructor in a technical, vocational or trade school.

The wholesale and retail selling of automotive parts and accessories, and the sale of cars, although not closely related, are other potential fields for the motor mechanic.

ADVANTAGES AND DISADVANTAGES

The work of the motor vehicle mechanic is interesting and varied and, as in the case of all technical skills, affords him the satisfaction of seeing the concrete results of his efforts.

Because the trade is practised in almost all parts of the country, the mechanic, if the need arises, can move about and still remain within the trade.

For the skilled mechanic, there is always the possibility of advancing to supervisory positions or to the establishment of his own business.

Although there is some seasonal variation in employment, this is, on the whole, of a minor nature. This is especially true in the towns and cities where year-round operation of motor vehicles is common. Unemployment caused by depression periods is less pronounced in the case of motor mechanics than in many other trades, especially for skilled mechanics.

Some of the disadvantages are that much of the work is done under unpleasant conditions—dirt, grease, oil, fumes, and at times wet and cold. There is a definite trend, however, towards improved working conditions.

There are certain occupational hazards. Accidents may occur in the use of hoisting equipment, machine tools and inflammable materials, but these can all be avoided with proper care. Health hazards due to fumes,

wet and cold have been greatly reduced in the case of the well heated and ventilated modern garage, but such hazards still exist in many other shops.

The trade is not strongly unionized, so that many of the benefits resulting from such organization are lacking.

LABOUR ORGANIZATION

Motor mechanics are not widely organized as a separate craft, but may belong to craft or industrial unions, the latter especially where their trade is practised in connection with some industry.

The very nature of their occupation—two to three in a garage in scattered locations—has made it difficult to organize.

TRENDS

Number and Distribution of Workers

Broadly speaking, the number of automotive mechanics and repairmen has kept pace in Canada with the increase in the mileage of good roads and the parallel growth of the number of internal-combustion engine propelled vehicles. The only comparable figures available on this trade group are those contained in the 1931 and 1941 census reports. These may not all be strictly automobile mechanics, since they are described merely as "Mechanics and Repairmen" (not elsewhere specified).

Mechanics and Repairmen

	1931	1941
Automobiles and cycles (mfg.)	1,762	2,852
Auto repair (incl. garages)	27,000	34,870
Cartage and trucking	153	125
Taxi and bus lines	129	200
Trade (retail)	937	1,370
Trade (wholesale)	100	367
	30,081	39,784

It is probable that nearly 5,000 of the 1941 total were self-employed.

To these should be added, in 1941, a proportion of 693 listed under "Farm machinery and implements", probably bringing the 1941 number up to 40,000. In 1931 the mechanics and repairmen listed under this heading numbered 298 only

The distribution regionally of these trademen is not directly ascertainable. It may, perhaps, be deduced from three factors:

(a) Density of population and urbanization.
(b) Degree of industrialization.
(c) Quality and extent of highways, and the year-round or seasonal use of these.

The only figures available are those of mechanics and repairmen generally by provinces, which should closely parallel those of the group under consideration, which probably constituted about 60 per cent of the total.

All Mechanics and Repairmen per thousand of population, 1941

Canada	**6**	**Ontario**	**7**
Prince Edward Island	**3**	**Manitoba**	**6**
Nova Scotia	**5**	**Saskatchewan**	**5**
New Brunswick	**4**	**Alberta**	**6**
Quebec	**6**	**British Columbia**	**7**

A numerical comparison, based on the 60 per cent proportion of mechanics and repairmen in the 1941 figures above mentioned, shows the following approximate distribution of these tradesmen, by provinces:

Prince Edward Island	**180**
Nova Scotia	**1,700**
New Brunswick	**1,000**
Quebec	**11,100**
Ontario	**15,000**
Manitoba	**2,700**
Saskatchewan	**2,400**
Alberta	**2,800**
British Columbia	**3,200**

Some recent figures on numbers of journeymen and apprentices are given below:

	Mechanics	Apprentices	Learners[4]	All
Newfoundland[1], 1950	330	12	81	423
Prince Edward Island	No registration			
Nova Scotia, 1948	1,461*	28		
New Brunswick, 1949	No registration	65		1,500
Quebec[2]				
Ontario, 1949	18,080*	2,511		
Manitoba, 1949	1,727*	216		
Saskatchewan, 1949[3]	1,700*	168		
Alberta, 1949	4,060*	715		
British Columbia, 1949	No registration	317		

[1] Estimate on 1/3 sample.

[2] Not available.

[3] Many mechanics not listed here who work under provisional and interim certificates. The 1,700 shown are fully certified journeymen.

[4] Only ascertainable in the case of Newfoundland.

*Certified Journeymen.

Age

It is estimated that in 1941 only 7 per cent of these workers were over 55 years of age. The age-group 25-44 constituted nearly 58 per cent. The latter group will be swelled by the number of World War II veterans entering the trade, at least 6,000.

Sex

The number of women engaged in this work is negligible, fewer than two hundred in 1941.

Growth

As indicated above, there is evidence that the number of mechanics of this type increased between the years 1931 and 1941 from about 30,000 to about 40,000. This increase, approximately thirty-three per cent, is greater proportionately than the eleven per cent by which the population of Canada grew in the same period. It may be related to the increase in passenger and freight road transport which went on during this by no means pros-

perous decade. The period 1930-1941 saw changes in numbers of establishments servicing vehicles as follows:

	1930	1941
Dealers	2,736	2,835
Garages	4,140	3,156
Filling Stations	5,503	10,130
	12,379	16,121

(The categories "garage" and "filling station" may not be clearly distinguished in many cases).

Between 1939 and 1947 there was an increase of 383,980, or 26.7 per cent, in the number of motor vehicles registered in Canada, bringing the total to 1,823,225. An analysis of the relative figures shows that the increase was:

Passenger cars	14.6 per cent
Commercial vehicles	82.8 per cent
Motor cycles	112.0 per cent

Evidence of the post-war increase in the use of motor vehicles is shown below, in percentages by provinces, for 1947 over 1945:

Prince Edward Island	12.6	Manitoba	20.9
Nova Scotia	24.0	Saskatchewan	13.0
New Brunswick	24.1	Alberta	19.4
Quebec	30.6	British Columbia	33.3
Ontario	20.3	Yukon and N.W.T.	190.9
All Canada	22.6		

New motor vehicles produced in Canada for the home market numbered in 1948:

Passenger cars	135,316
Trucks	72,888
Buses	694

There is every reason to believe that the 1949 output for use in Canada was even greater. The importation of British cars from 1948 on has been on a scale sufficient to warrant the setting up of agencies for selling and servicing them, and the appeal, to some consumers, of the fuel economy and parking advantages of these may

give them a lasting market in Canada, providing work for the mechanics who have specialized in their maintenance and repair.

There has been, in recent years, very little seasonal unemployment in this trade. The keeping open of highways and secondary roads in all seasons has been a factor in maintaining a reasonably high level of work in the servicing and repair fields. Highway freight and passenger traffic is now on a year-round basis. The only heavy falling-off in the use of automobiles in winter is in the urban and suburban areas where alternative public passenger service exists, and in long-distance pleasure and holiday driving. This is, however, more than covered by the increased servicing required by winter-driven vehicles. As long ago as 1941, sixty per cent of all wage earning motor mechanics had fifty or more weeks employment in the year.

Present Labour Demand and Supply

A clearer picture of seasonal influences on employment can be seen in the tabulation on Page 31 of Unfilled Vacancies and Unplaced Applicants:

Interpretation of the figures given, however, should be in the light of the following factors:

(a) Many employers do not register their vacancies with the National Employment Service, since contacts are often established personally in a small personally-managed type of business. Advertising is freely used, the aim being to get the best workers.

(b) In provinces where licensing of mechanics is not general large numbers of unqualified men will register for this work. Several employers state that even where licensing is general, many applicants are not qualified. Partially trained men are reported to be common among seekers for jobs in several areas.

(c) The tendency toward specialization, not only in the type of job performed, but in the make of vehicle worked on, will narrow employment fields for individuals.

AUTOMOBILE MECHANICS AND REPAIRMEN
DEMAND AND SUPPLY

U.V.—Unfilled Vacancies. U.A.—Unplaced Applicants.

	Canada		Maritimes		Quebec		Ontario		Prairie		Pacific	
	U.V.	U.A.	U.V.	U.A.	U.V.	U.A.	U.V.	U.A.	U.V.	U.A.	U.V.	U.A.
Dec. 31, 1948	319	1,294	10	207	41	316	173	173	74	304	21	294
Feb. 3, 1949	250	1,904	14	288	32	450	112	308	74	431	18	427
Mar. 3, 1949	277	2,068	14	324	28	520	134	262	89	470	12	492
Mar. 31, 1949	415	1,903	26	351	48	531	179	253	146	424	16	344
Apr. 28, 1949	606	1,127	30	250	122	315	251	132	180	204	23	226
June 2, 1949	669	780	40	218	143	196	277	95	173	105	36	166
June 30, 1949	579	689	35	193	93	168	285	82	135	100	31	146
July 28, 1949	595	672	29	158	107	180	297	99	123	95	39	140
Sept. 1, 1949	550	709	29	177	79	200	268	98	143	64	31	170
Sept. 29, 1949	379	795	21	192	43	236	204	99	87	103	24	165
Nov. 3, 1949	342	1,098	14	230	30	331	207	143	86	185	5	209
Dec. 1, 1949	301	1,433	7	301	19	415	192	170	73	250	10	297
Dec. 29, 1949	208	2,044	8	396	8	623	130	238	57	353	5	434
Feb. 2, 1950	200	2,966	6	518	13	822	104	322	72	655	5	649

SOURCE: National Employment Service Records.

Future Employment Prospects

The long-range outlook seems to be favourable in the case of qualified men.

Though business is reported, by some representative employers, to be likely to remain close to its 1949-50 level for some time to come, there seems no ground for anticipation of a falling-off. The reconditioning of used cars, "turned in" on new ones, is increasing. Increases in the mechanization of farm operations, in the use of diesel power, in the number of motor buses in urban and long-distance transportation, and in the mileage and improvement of highways, are all favourable factors.

Opinions obtained from proprietors and executives in the trade agree that there is likely to be plenty of work for good men. The placement officer of a large technical school in Ontario stated that the number of requests received in recent years for graduates in motor mechanics exceeded that of those available.

CONCLUSION

It would appear, from present indications, that prospects for a steady and progressive career in this trade are promising, in the case of those young men who are able to obtain and complete a course of technical training, followed by apprenticeship, and to qualify as journeymen on the completion of the latter.

Interesting possibilities are opening up through such radical technological changes as that which the jet-turbine engine may bring about; the rear-engine, front-drive, four-wheel drive and similar experimental developments may also create minor revolutions in the mechanic's craft.

Immigration, natural population increase, improving living standards, as well as the developments in highways and in public transportation, will all have a favourable effect on employment in this trade. The natural resources being made available now—iron in north-western Ontario and in Quebec and Labrador, oil in Alberta and Saskatchewan, will all require, for their development, more tracked vehicles, trucks and cars.

The record of the 1930's does not indicate that any great falling-off in this work took place in that decade of low employment. The factor which might have the most adverse effect on this trade is probably any period of scarcity of gasoline, such as occurred in the late war. The automobile is so essential an item in every-day life, to at least two generations, that it is one of the last expenses to be foregone when income is reduced. When economic conditions reduce the purchasing of new cars, the mechanic and repairman is needed more than ever to service the older models which are kept in use longer than they would be in better times.

The outlook for the partially-trained man is not good, in this trade. Competition for the work he can do is likely to be excessive, and should there be any deterioration in economic conditions the employment of this type will be precarious.

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AUDIO-VISUAL MATERIAL

Readers desiring information on film sources, available material, and the organization of local film services may obtain it from the National Film Board offices listed in Monograph I, "*Carpenter*".

LOCAL INFORMATION

LOCAL INFORMATION

"CANADIAN OCCUPATIONS" SERIES

The monographs listed below, accompanied by pamphlets in the case of numbers 1 to 11, have been published to date. Those from 20-35 have been published collectively.

(1) *Carpenter*

(2) *Bricklayers and Stone Masons*

(3) *Plasterer*

(4) *Painter*

(5) *Plumber, Pipe Fitter and Steam Fitter*

(6) *Sheet-Metal Worker*

(7) *Electrician*

(8) *Machinist and Machine Operators (Metal)*

(9) *Printing Trades*

(10) *Motor Vehicle Mechanic and Repairman*

(11) *Optometrist*

Careers in Natural Science and Engineering: (20-35)

(20) "Agricultural Scientist"

(21) "Architect"

(22) "Biologist"

(23) "Chemist"

(24) "Geologist"

(25) "Physicist"

(26) "Aeronautical Engineer"

(27) "Ceramic Engineer"

(28) "Chemical Engineer"

(29) "Civil Engineer"

(30) "Electrical Engineer"

(31) "Forest Engineer and Forest Scientists"

(32) "Mechanical Engineer"

(33) "Metallurgical Engineer"

(34) "Mining Engineer"

(35) "Petroleum Engineer"

DEPARTMENT OF LABOUR

Economics and Research Branch

OTTAWA, 1950

OTTAWA
EDMOND CLOUTIER, C.M.G., B.A., L.PH.,
KING'S PRINTER AND CONTROLLER OF STATIONERY

CANADIAN OCCUPATIONS

★

MOTOR VEHICLE MECHANIC

★

MONOGRAPH 10

REVISED 1959

DEPARTMENT OF LABOUR, CANADA

CANADIAN OCCUPATIONS MONOGRAPHS

(1) Carpenter
(2) Bricklayers and Stone-Masons
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(8) Machinist and Machine Operators (Metal)
(9) Printing Trades
(10) Motor Vehicle Mechanic
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(27) ——
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(30) Electrical Engineer
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(34) Mining Engineer
(35) Petroleum Engineer

(36) Hospital Workers (other than Professional)
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(45) Physical and Occupational Therapist.

All monographs in the CANADIAN OCCUPATIONS series are priced at 10 cents per copy, with the exception of *Careers in Natural Science and Engineering,* which is 25 cents. A discount of 25 per cent is allowed on quantities of 100 or more of the same title.

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CANADIAN OCCUPATIONS

★

MOTOR VEHICLE MECHANIC

MONOGRAPH 10

REVISED 1959

HON. MICHAEL STARR, MINISTER
A. H. BROWN, DEPUTY MINISTER

DEPARTMENT OF LABOUR, CANADA

45

FOREWORD

During recent years there has been a steadily increasing demand for up-to-date information on occupations.

This demand comes from youth faced with the need of choosing an occupation and of selecting the type of training required; from parents, teachers and other counsellors; from workers shifting to other occupations; from employment service officers; from directors of personnel and union officials, and from other quarters.

This series of monographs and an accompanying series of pamphlets, the latter containing similar information in a condensed form, are attempts to meet this demand. These publications are designed for general use and cover a wide range of occupations, including professions. They indicate, among other things, the nature of the occupation or group of occupations, entrance and training requirements, working conditions and opportunities in each.

The staff of the Occupational Analysis Section has prepared this series with the generous assistance of representatives of management, trade unions, and professional associations. The co-operation of the Unemployment Insurance Commission, the Vocational Training Branch of the Department of Labour, and the Dominion Bureau of Statistics is gratefully acknowledged.

Acknowledgment is also made of the assistance obtained from numerous publications on occupations prepared in Canada and in other countries.

DIRECTOR,
Economics and Research Branch,
Department of Labour.

October 1959.

MOTOR VEHICLE MECHANIC

Photo: N.F.B.

The Motor Vehicle Mechanic Performs an Essential Public Service

HISTORY AND IMPORTANCE

The rapid development of motor vehicles as an integral part of modern living has made the motor vehicle mechanic an indispensable member of the community. There are about four million motor vehicles being operated on Canadian highways today. The army of mechanics servicing these vehicles is estimated to number well over 64,000, yet there is a shortage of qualified men in the trade. Working in a network of 25,000 garages that spreads from coast to coast, mechanics may be found in practically all sections of the country.

The development of the motor vehicle itself is an exciting chapter in human history and we wonder if the early inventors

ever dreamed of the impact that their "horseless carriage" would have on society in years to come.

A Frenchman named Cugnot built the first motor vehicle, which was steam powered, in 1770. However, it was not until 1888 that Serpollet produced the first boiler which was a practical success for use in a steam-driven car.

The use of steam power in motor vehicles was doomed when, in 1867, Otto invented an internal combustion engine that burned illuminating gas and Daimler, in 1884, patented a gasoline engine that was similar in its essential features to the modern four-cycle engine.

By 1900, motor buses were already running in London, and inventors in all industrialized countries were working on improvements in cars, some of which developed into the now familiar gear-shifts, drive-shafts, differentials, ignition systems, steering gear, lighting systems and the countless details that make up the modern car.

Although the motor vehicle was born in Europe, the problem of economical mass production was solved in the United States by Henry Ford and his competitors. Using assembly line methods, it was possible to produce in quantity vehicles which previously had been largely custom jobs, individually built. Thus the popular demand for a low-priced car was met, and by the outbreak of the First World War, automobiles were becoming commonplace.

The motor vehicle quickly became an essential feature of everyday life as the internal combustion engine proved itself to be a convenient, economical and versatile source of power. The development of the truck, the tractor-trailer, the passenger bus, the farm tractor, the bulldozer, and other mechanized equipment followed rapidly.

The manufacture of motor vehicles and motor vehicle parts is now one of Canada's major industries. Total production in 1956, a peak year, amounted in value to over $988,000,000. The number of vehicles produced that year exceeded 467,000.

Although the early automobiles were far less complex than those of today, they broke down frequently, and repairs had to be made by local handymen, machinists, blacksmiths or bicycle re-

pairmen. As the number of cars increased, the demand for motor vehicle mechanics grew, and garages, staffed by trained men, began to make their appearance.

In the early days of the automobile, and for some time afterwards, training in this trade was rather haphazard. The best mechanics were usually men who had trained as machinists and applied their knowledge to the internal-combustion engine. Other motor mechanics acquired their skill by working on cars in a garage, either alone or as a helper.

A more systematic and broader training was necessitated as motor vehicles became more varied, more advanced in design, and were made to finer tolerances. The development of complex testing equipment and tools, which made possible a greater refinement of adjustment, also added to the need for a more comprehensive system of training.

FIELD AND NATURE OF THE WORK

General Definition

Motor vehicle mechanics are skilled workers who adjust, repair or replace worn or damaged mechanical, electrical and body parts of passenger cars, trucks, buses, motorcycles, tractors and other internal-combustion powered vehicles. For the purposes of this monograph, the term "automobile mechanic" will be used synonymously with that of "motor vehicle mechanic" or "motor mechanic".

There are two main groups of motor vehicle mechanics: *general automobile mechanics,* who are fully skilled in general repair work, and *specialists,* who are also fully skilled in general repair work but who specialize in one or more aspects of the work —e.g. *automobile electrician, brake repairman, wheel alignment mechanic, motor* or *engine mechanic.*

Although a *body and fender mechanic* is a motor vehicle mechanic, he does not require a knowledge of the principles of the internal-combustion engine, nor is he concerned with the other mechanical or electrical parts of the motor vehicle. His work is separate from that of the general automobile mechanic and consists mainly of repairs to fenders, door panels and roof tops, and

calls for skill in sheet metal work, welding and painting. In some provinces, body and fender work has become a separate apprenticeable trade.

Automobile mechanics may also work on diesel-powered motor vehicles. Such mechanics require additional training in the principles of the diesel engine, its maintenance and repair.

Farm vehicles, especially tractors, and earth-moving equipment such as bulldozers, which may be either gasoline or diesel-powered, are also repaired by motor vehicle mechanics.

The automobile upholsterer does not come within the classification of automobile mechanic. As a rule, difficult upholstery or trimming work is done by a regular upholstering establishment, simpler work by the body and fender man.

Field of Work

The majority of motor vehicle mechanics are employed in general repair garages, in the service departments of automobile and truck dealers, and in specialty garages. In the large dealer shops and in some independent repair garages, where the work is departmentalized, it is customary for mechanics to specialize. Men employed in such shops may, however, be shifted from one department to another, depending on the extent and kind of work on hand, so that the mechanic's duties may be more varied in such establishments than in specialty garages. Specialty garages usually concentrate upon one particular service, such as carburetor and ignition repair, body and fender repair, and radiator repair.

Many large firms in the commercial, manufacturing, construction and transportation fields operate garages to service their own fleets of cars, trucks and other motor vehicles. Examples of these are department stores, food distributors, delivery firms, construction contractors, bus lines, taxi companies, etc. Governments — federal, provincial, and especially municipal — also operate garages for all types of publicly owned motor vehicles.

There are many types of internal-combustion engines used in petroleum exploration, pipe-line construction, and oil transportation, which call for the services of skilled automotive mechanics.

A small number of skilled mechanics are employed by automobile service stations. Some of these service stations do either

general or specialized repairs (usually on passenger cars and light trucks), but many do only minor adjustments and repairs, or install auto accessories, so that the need for the skilled mechanic in this field is not great.

Automobile mechanics are also employed by automobile and truck manufacturing concerns, where they repair and replace defective motors and parts.

Duties

General Automotive Mechanic

Determines either by personal inspection, questioning the driver, or by use of special instruments and mechanical devices, the cause of faulty operation; disassembles parts of the vehicle, such as motor, transmission, clutch, differential, steering mechanism and electrical system, using necessary hand tools and specialized equipment; repairs or replaces worn or damaged parts; reassembles the parts in correct arrangement, making necessary adjustments for alignment or clearance; and performs other related repair tasks to place the vehicle in operative condition.

The duties of the general automobile mechanic vary according to the type of motor vehicle usually serviced in a particular establishment. For example, he may work on automobiles and light trucks, heavy trucks, buses, and other vehicles both gasoline and diesel-powered.

In addition to the duties already mentioned, the heavy-truck and bus mechanic maintains and repairs air and hydraulic couplings, and other connective mechanisms; air, electric and hydraulic brake systems; auxiliary mechanisms including winches, pumps, dumping or lifting apparatus, refrigerating equipment, trailers and trailer equipment, etc.

The diesel-engine automobile mechanic performs repair and overhaul work similar to that of the general automotive mechanic, on trucks, buses, etc., that are equipped with diesel engines. In addition, he repairs and maintains fuel injection systems, fuel or spray nozzles, fuel-transfer or oil-supply pump and governor, and times the fuel injection pump.

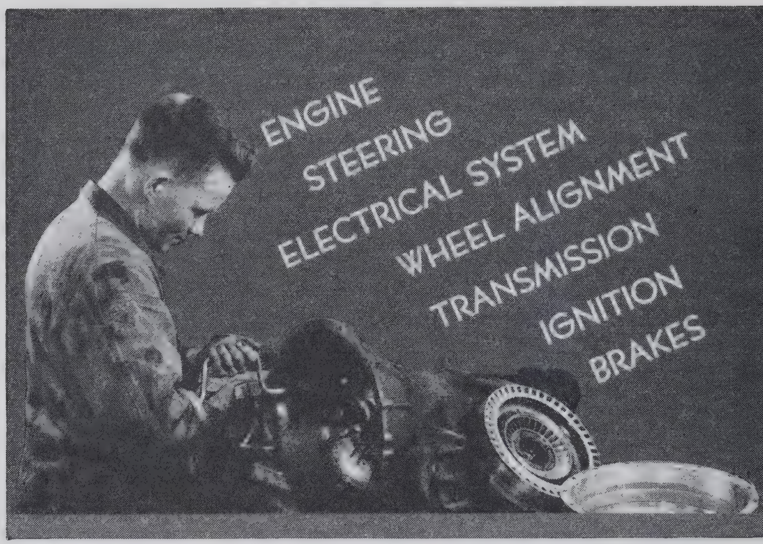

Photo: N.F.B.

The Journeyman May Specialize.

Specialty Automotive Mechanics

As mentioned previously, these workers are usually genera automotive mechanics who have specialized in one particula phase of repair. They are usually employed in departmentalize or specialty garages, and at slack periods may be shifted from one phase of the work to another. Some of the specializations, with their particular duties, are as follows:

Automobile Electrician — repairs and installs ignitio systems, starters, coils, generators, condensers, distributors panel instruments, and other electrical equipment on variou types of motor vehicles, using necessary hand tools an mechanical and electrical testing devices. May do moto tune-up, and, if qualified, may test, repair and install auto-mobile radios and aerials.

Brake Repairman — tests, overhauls, and adjusts me-chanical, electrical, air and hydraulic brake systems on variou

types of motor vehicles. Usually operates a brake-drum lathe to re-surface scored brake drums. May repair and install shock absorbers and leaf or coil springs.

Wheel Alignment Mechanic — tests for and corrects alignment of automobile, truck, bus and tractor frames, wheels, steering-gear and front axle assembly, using necessary hand tools and mechanical testing or corrective devices. May weld, bend or otherwise straighten axles, and repair or install shock absorbers and springs.

Automobile Mechanic, Motor — repairs and installs motors in all types of motor vehicles. May work entirely at a bench, doing inspection and adjustment of motors.

Automobile Radiator Man — tests, cleans and repairs automobile, truck, bus and tractor radiators, pumps and other parts of cooling system. Work usually involves testing radiator, motor block, hoses, and pumps for leaks; checking, repairing or installing hoses, thermostats and pumps; soldering radiator cores and cleaning entire cooling system.

Auto Body Mechanic — repairs or replaces damaged fenders, door panels and roof tops: hammers out dents; smooths hammered area by filing or by grinding or sanding it with small electric grinding or sanding wheel. May fill badly dented areas with solder if hammering and filing does not remove dents, and file solder until area is smooth and blends with adjacent surface. May weld breaks in body metal and smooth the rough weld with a file. Prepares surface properly for painting. May paint damaged part or whole vehicle, using a spray gun.

Although the automobile radiator man and the auto body mechanic are considered to be specialists, they are not usually all-round mechanics.

QUALIFICATIONS

The normal entrance age for apprenticeship in this trade varies from 16 to about 21. In British Columbia apprenticeship regulations stipulate 15 as the minimum entrance age; in Ontario and Manitoba the maximum age is set at 21, and in Quebec 25, although older applicants may be approved in some cases. No maxi-

mum age is set in the case of Newfoundland, Nova Scotia, New Brunswick, Saskatchewan, Alberta and British Columbia.

The academic requirements called for by apprenticeship regulations are not high. There is no definite minimum specified in Alberta or British Columbia. In the other provinces, the minimum requirements are: Quebec, grade 6; Ontario and Saskatchewan, grade 8; New Brunswick and Manitoba, grade 9; Newfoundland and Nova Scotia, grade 10. Educational requirements for auto body mechanics are set at grade 8 in New Brunswick and Saskatchewan.

A person considering this trade should have an aptitude for, and an active interest in, working with his hands and with mechanical things. A pleasing personality, and the ability to deal with the public and fellow employees are important qualifications for the mechanic who aspires to the position of service manager.

Because of the physical movements involved in the occupation — a great deal of standing, reaching, lifting, carrying, pushing, pulling, handling and fingering; a moderate amount of walking, turning, stooping, crouching, kneeling and sitting; and a small amount of balancing and climbing — the motor vehicle mechanic should be physically strong and agile, have good health and endurance, fairly good eyesight (with or without correction), and fairly good hearing. The occupation also calls for strong arms and legs and a good degree of dexterity in hand and finger movement. Some employers require that workers pass a physical examination before they are hired.

The trade of motor vehicle mechanic does provide some opportunity for certain handicapped individuals. Workers with finger disabilities, blindness in one eye, poor hearing, flat feet or fallen arches, are not barred from employment. Poor eyesight, missing limbs and certain pulmonary ailments are handicaps in gaining employment. There are instances, not too common, of successful workers in this occupation who have the use of only one leg or have limited use of both legs.

PREPARATION AND TRAINING

One interested in entering this trade would do well to get as much secondary school training as possible, preferably at a technical or vocational school offering a course in motor vehicle repair

work. The practical experience and the theoretical knowledge gained from such a course, not only in motor mechanics, but in such general subjects as mathematics, chemistry and physics, provide a valuable preparation for apprenticeship. The student who completes such a course, or who has taken a good part of it, will be more readily accepted as an apprentice than one who has not had any preliminary training. Another advantage is that a time credit is usually allowed for training at a recognized vocational school and the term of apprenticeship correspondingly shortened.

The majority of Canadian provinces, recognizing the need for systematic training in this trade, have established apprenticeship programs for the training of motor vehicle mechanics. In addition, some provinces have established pre-apprenticeship courses.

Mention has been made of the desirability of a technical or vocational school course as preparation for apprenticeship. The same can be said for provincial pre-apprenticeship courses. The plan calls for a trainee to attend full-time classes at one of the provincial centres for a period of about six months, receiving a weekly allowance during the training period. At the end of the course, trade tests are given and the trainee rated according to his proficiency.

At the present time, pre-apprenticeship courses for motor mechanics are being conducted in Newfoundland, Nova Scotia, New Brunswick, Manitoba and Alberta. In the case of Alberta, a trainee must first become indentured as an apprentice before he is eligible for such a course. This is not required in the other four provinces.

Apprenticeship Training

One can become an all-round mechanic in one of two ways, either as an apprentice or as a helper. Training as an apprentice is the more desirable for several reasons: there is an agreement between the employer and the apprentice which provides for a progressive and thorough training; in the majority of provinces apprenticeship training is controlled by provincial Apprenticeship Boards (in Quebec, by local Apprenticeship Commissions); also, a minimum wage rate, which is on a progressive scale, is laid down by the apprenticeship authorities. These factors do not apply in the case of the helper. Despite this, it is only fair to say that

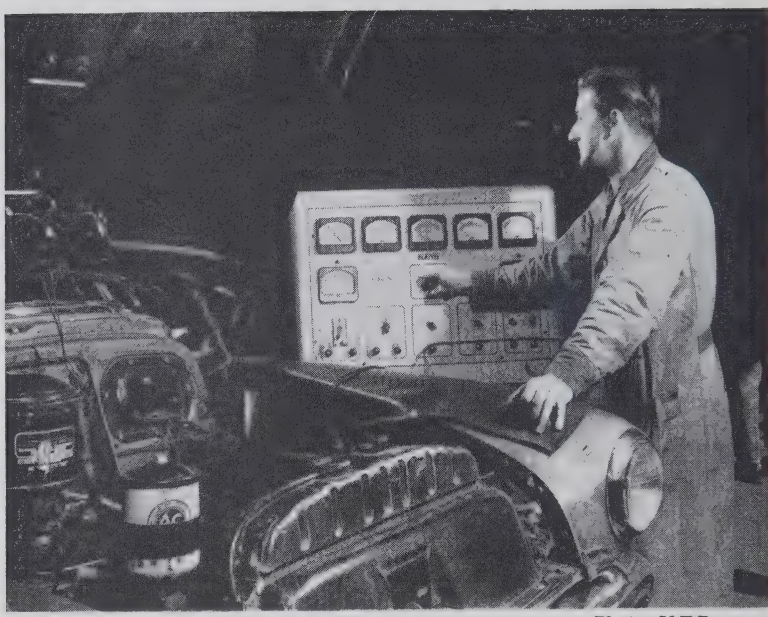

Photo: N.F.B.

The Apprentice Learns to Diagnose Trouble Scientifically.

helpers do, in many instances, get an all-round training in the trade. Much depends on the employer.

Apprentice training lasts for four years in some provinces, five years in others, each year representing a specific number of work-hours. Many think this training period is unnecessarily prolonged. It is held by the trade, however, that the stipulated term does not only represent the time required to learn the various operations, but also the period necessary for the apprentice to encounter the various jobs a number of times and to be able to do the work in a reasonable length of time.

The term of apprenticeship may be reduced by previous experience in the field, training in related subjects in technical or vocational schools, or pre-apprenticeship courses.

The apprentice learns by working under the supervision of a qualified motor mechanic. Starting with simple tasks in the garage or shop, he follows a progressive program of work in accordance with a suggested schedule from the apprenticeship authorities. Later he learns to master the intricacies of complex parts, such as carburetors and transmissions. In some garages, the repair of automotive farm equipment, such as tractors and combines, may form a large part of the day's work. Apprentices working in these garages will acquire considerable experience on this type of equipment. In garages equipped to handle the maintenance and repair of diesel-powered equipment, the apprentice may learn this specialized branch of the trade along with general automotive work.

To round out on-the-job experience, the apprentice will usually be required to take classroom instruction at a technical or vocational school for periods ranging from six to twelve weeks per year, depending on the province. The apprentice usually receives a weekly training allowance while attending classes. In class, the apprentice learns the reasons for certain shop practices. He also learns the mechanical principles behind the operation of internal-combustion engines and other parts of motor vehicles.

The following shows the length of the apprenticeship period and the full-time classroom instruction schemes in effect in the various provinces in which motor vehicle repair is a designated trade. In some provinces, where it is difficult for apprentices to attend full-time day classes, the equivalent may be obtained in evening classes.

Newfoundland	**Four years,**	first year	— 8 weeks;
		second year	— 6 weeks;
		third year	— 3 weeks;
		fourth year	— 3 weeks.
Nova Scotia	**Four years,**	first year	— 10 weeks;
		next two years	— 4 weeks per year;
		fourth year	— 5 weeks.
New Brunswick	**Four years,**	9 weeks per year.	
Ontario	**Five years,**	second year	— 10 weeks;
		fourth year	— 10 weeks.
Manitoba	**Five years,**	Junior	— 6 weeks;
		Intermediate	— 6 weeks;
		Senior	— 4 weeks.

Saskatchewan	**Five years,**	first year	—	8 weeks;
		second year	—	8 weeks;
		third year	—	8 weeks;
		fifth year	—	7 weeks.
Alberta	**Four years,**	first year	—	8 weeks;
		second year	—	8 weeks;
		third year	—	6 weeks;
		fourth year	—	6 weeks.
British Columbia	**Four years,**	4 weeks per year.		

In a trade such as motor vehicle repair, home study courses are useful supplements to, but not substitutes for, practical training. Correspondence courses in auto and diesel mechanics are available from the Departments of Education in Nova Scotia, Quebec, Ontario and British Columbia. These courses, listed in Appendix I, are available to residents of all provinces and are reasonably priced. The courses prepared by the province of Quebec are in French.

When an apprentice has passed his final tests, standardized in eight of the ten provinces, he receives his journeyman's papers showing that he has served his time in the trade.

Some capital investment is necessary, as every mechanic must have his own tool kit. The amount invested will vary. A general mechanic may spend from $100 to $150 on his initial kit and then add to it as he is able. Employers frequently assist the apprentice in financing tool purchases.

For the automobile mechanic, training is a continuous process. The many innovations, models and methods in the field, make it necessary for the worker to spend considerable time studying trade books or taking special courses. Some employers arrange for regular refresher courses for their employees.

ENTRY INTO THE OCCUPATION

The National Employment Service, working in co-operation with school placement officers and officials of the Apprenticeship Branches of the provincial Departments of Labour, assists young men in becoming established in training as apprentices.

Many young men get a start in the trade through personal contacts or by working in a garage or service station after school

Photo: N.F.B.

Refresher Courses Keep Mechanics Up to Date.

hours or during vacations. Also, the daily newspapers regularly carry advertisements for experienced motor mechanics and apprentices.

EARNINGS

Wages paid to motor mechanics vary widely, influenced as they are by such factors as locality, type of garage, skill level of the worker, and the length of the work-week. Another factor that makes for differences is that mechanics are mainly paid in one of two ways — either on a flat-rate or piece-work basis, or by the hour.

The flat-rate or piece-work scheme works as follows: the garage sets a definite time for the completion of each type of repair (usually following the times suggested by the manufacturer).

For example, a certain repair job may be fixed at five hours. The customer is charged a fixed rate, the mechanic receiving 40 to 45 per cent of the charge as his share. If the mechanic completes the job in less than five hours, he still gets paid for five hours' work. The repair times are set so that a good mechanic usually completes a job within the time limit. Under this system, the mechanic must be accurate, as well as fast, since he is not paid for work that has to be redone. Higher rates for overtime are not common under the flat-rate scheme. In some garages, workers are assured of a minimum weekly wage in order to take care of a temporary decrease in work.

The hourly rate system of pay is common to municipal and private transportation garages — bus, railway, taxi and trucking. Workers are paid a fixed amount per hour, whether or not there is any work. Earnings under this system, however, may not be as high as under the flat-rate scheme in the case of experienced men. Time-and-a-half for overtime is paid in many cases.

Based on incomplete returns,[1] average hourly straight-time earnings varied from $1.54 in the Maritimes to $2.26 on the West Coast, with an average of $1.91 for all Canada.

The Apprenticeship Boards of the various provinces set the minimum wage rate for apprentices, calculated as a percentage of the prevailing rate paid the journeymen in the garage. Increases are granted every 6 months in some provinces and every 12 months in others.

Although pension schemes are by no means general, a number of garages have set up contributory plans for their employees and these, plus other benefits, are factors in earnings.

WORKING CONDITIONS

Working conditions for motor mechanics vary according to the type of garage. On the one hand there is the modern, well planned establishment, which is well lighted, ventilated and heated, and has lunch-room, locker and washroom facilities. The flow of work is

1. Department of Labour, Economics and Research Branch, October 1958.

Photo: N.F.B.

The Journeyman May Become a Foreman.

organized and facilitated by many time and labour-saving devices. On the other hand, there are still many shops that have poor lighting, heating and ventilation, and where the mechanic has to work in cramped space and with fewer labour-saving devices. The increased floor space of large garages has eliminated much of the outdoor repair work on vehicles, but this is not possible in the case of many small firms.

ADVANCEMENT

The usual line of advancement for motor mechanics is from apprentice to journeyman, journeyman to foreman, and foreman to service manager or superintendent. Beyond the journeyman stage, advancement is necessarily slow because of the small number of supervisory positions.

Going into business on one's own is another possibility for the experienced mechanic who has sufficient capital and a good knowledge of business management. The amount of capital required depends entirely on the size and type of garage planned.

RELATED OCCUPATIONS

Occupations that are concerned with the assembly, repair and maintenance of internal-combustion engines are all closely related to that of the motor mechanic. Some of these are:

- Aircraft-Engine Mechanic (air transportation; aircraft manufacturing)
- Aircraft-Engine Assembler (air transportation; aircraft manufacturing)
- Engine-Service Mechanic (air transportation)
- Engine Tester (air transportation; aircraft manufacturing)
- Diesel Mechanic (any industry)
- Motor and Chassis Inspector (auto manufacturing)
- Experimental Mechanic (auto manufacturing)

Another closely related occupation is that of motor vehicle mechanic instructor in a technical, vocational or trade school.

The wholesale and retail selling of automotive parts and accessories, and the sale of cars, although not closely related, are other potential fields for the motor mechanic.

ADVANTAGES AND DISADVANTAGES

The work of the motor vehicle mechanic is interesting and varied, and, as in the case of all technical skills, affords him the satisfaction of seeing the concrete results of his efforts.

Because the trade is practised in all provinces in Canada, the mechanic, if the need arises, can move about and still remain within the trade.

For the skilled mechanic, there is always the possibility of advancing to supervisory positions or establishing his own business.

Although there is some seasonal variation in employment, it is generally of a minor nature. This is especially true in the towns and cities where year-round operation of motor vehicles is com-

mon. During business recessions employment is more stable than in many other trades, especially for skilled mechanics.

Some of the disadvantages are that much of the work is done under unpleasant conditions — dirt, grease, oil, fumes, and at times wet and cold. There is a definite trend, however, towards improved working conditions.

There are certain occupational hazards. Accidents may occur in the use of hoisting equipment, machine tools and inflammable materials, but these can all be avoided with proper care. Health hazards due to fumes, wet and cold have been greatly reduced in the case of the well heated and ventilated modern garage, but such hazards still exist in many other shops.

LABOUR ORGANIZATION

Motor mechanics may belong to craft or industrial unions, the latter especially where their trade is practised in connection with some industry or service. The very nature of their employment — two to three in a garage in scattered locations — has made it difficult to organize the trade. Consequently, many of the benefits resulting from such organization are lacking.

TRENDS

Growth

By 1951, the number of motor vehicle mechanics had reached a total of 64,328, an increase of 60 per cent over the estimated 40,000 in 1941. Over this period, however, the growth in the number of mechanics failed to keep pace with the rise in the number of motor vehicle registrations, which showed an increase of over 80 per cent.

Between 1951 and 1955, motor vehicle registrations increased by a further 37.5 per cent, whereas the number of apprentice mechanics (excluding those in Quebec) rose by only 12 per cent. The supply situation for mechanics would have been quite serious had it not been for immigration — some 9,000 immigrants, who were classified as automobile mechanics, came into Canada during this period. Immigration, however, cannot be expected to continue to contribute to the supply of mechanics at the same high level —

from a high of 2,900 in 1951, the number of immigrant mechanics had declined to 850 in 1955.

If, as expected, the number of motor vehicles continues to increase at a rapid rate, the likelihood is that the shortage of mechanics will, in the light of the immigration picture, be felt more heavily from now on.

Distribution of Mechanics

Ontario and Quebec together accounted for 60 per cent of all motor vehicle mechanics in Canada in 1951. Among the western provinces, British Columbia led with 9.3 per cent, followed by Alberta with 8.7 per cent. It is interesting to note, though, that each of the western provinces had a higher proportion of mechanics per 1,000 population than any of the other provinces. This is a reflection of proportionately higher motor vehicle registrations in the western provinces.

DISTRIBUTION OF MOTOR VEHICLE MECHANICS BY PROVINCE, 1951.

	Number	Per Cent	Number per 1,000 of Population
Canada	64,328	100.0	4.6
Newfoundland	872	1.4	2.4
Prince Edward Island	397	.6	4.0
Nova Scotia	2,427	3.8	3.8
New Brunswick	2,033	3.2	4.0
Quebec	15,621	24.2	3.8
Ontario	22,913	35.5	5.0
Manitoba	4,108	6.4	5.3
Saskatchewan	4,418	6.9	5.3
Alberta	5,579	8.7	5.9
British Columbia	5,960	9.3	5.1

Source: 1951 Census of Canada, D.B.S.

Service garages are the largest employers of automobile mechanics, followed by wholesale and retail trade.

Age Groups

In 1951, motor vehicle mechanics fell into the following age groups: age 24 and under — 20.2 per cent; between 25 and 54 — 74.1 per cent; 55 and over — 5.6 per cent. The 55-and-over

age group decreased from an estimated 7 per cent in 1941 to 5.6 per cent in 1951. Because of the very low proportion of mechanics in the older age groups, it can be expected that future employment opportunities will be more dependent on expansion of the trade rather than on turnover owing to deaths and retirements.

Length of Work Year

There has been, in recent years, very little seasonal unemployment in this trade. In 1941, about 60 per cent of all wage-earning motor mechanics had fifty or more weeks of employment in the year; by 1951, the proportion had risen to 75 per cent.

The fact that highways and secondary roads are kept open in all seasons has been a factor in maintaining a reasonably high level of work in the servicing and repair fields. Highway freight and passenger traffic is now on a year-round basis. There may be some falling-off in the use of automobiles in winter in urban and suburban areas, where alternative public passenger service exists, and also because of the reduction in long-distance pleasure and holiday driving. This is, however, more than compensated for by the increased servicing required by winter-driven vehicles.

Employment Prospects

A comparison of vacancies in this trade and registrations for employment as listed by the National Employment Service, reveals that motor vehicle mechanics are in short supply in Canada as a whole, and in the Quebec, Ontario, Prairie and Pacific regions in particular.

Employment prospects for the well trained mechanic are very good. Many factors point to an increasing need for the services of skilled motor mechanics.

The greatest single factor is the tremendous increase in the number of registered automobiles, which is expected to reach 5 million by 1960.

Other factors favorable to the motor mechanic are the increasing mechanization of farm operations and the use of diesel power in industry. The development of natural resources, such as iron in north-western Ontario and in Quebec and Labrador, oil in

Alberta and Saskatchewan, and the expanding construction industry, will require more tracked vehicles, trucks and other powered equipment.

A rising standard of living with more leisure time permits greater use of the automobile for pleasure driving. The completion of the Trans-Canada highway and development of other arterial systems should lead to an increase in tourist travel, bus travel and long-distance truck hauling.

The automobile is so essential an item in everyday life, to at least two generations, that it is one of the last expenses to be foregone when income is reduced. If economic conditions should reduce the sale of new cars it is certain that the older models would be kept in use longer, making the mechanic's services even more necessary.

Although employment prospects for motor vehicle mechanics are good, this applies mainly to the qualified journeyman. If competition for employment becomes keen, the position of the partially trained man will become less secure.

SUGGESTED READING

The Guidance Centre, Ontario College of Education, Toronto, Monograph, *Automobile Mechanic* (1958).

General Motors Products of Canada Limited, Oshawa, Ontario, Booklets, *Key to Careers in the Retail Automotive Business,* and *Automotive Jobs in Yourtown.*

Michigan State Employment Service, Detroit, "Occupational Guide" series, No. 30, *Automobile and Truck Mechanics* (1954).

APPENDIX 1

The catalogue "Canadian Vocational Correspondence Courses" lists 108 home study courses in various vocational subjects and can be obtained by writing to your provincial Department of Education or to the Vocational Training Branch, Department of Labour, Ottawa.

The following courses are included in this catalogue:

Automotive Mechanics I, Ontario — 20 Lessons — Fee $10.
Prerequisite — Grade VIII Mathematics.

Automotive Mechanics II, Ontario — 20 Lessons — Fee $10
Prerequisite — Grade VIII Mathematics.

Auto Mechanics I, B.C. — 20 Lessons — Fee $12.
Prerequisite — Garage experience or Grade X Mathematics and Science.

Auto Mechanics II, B.C. — 20 Lessons — Fee $12.
Prerequisite — Auto Mechanics I.

Automotive Spray Painting, N.B. — 18 Lessons — Fee $18
Prerequisite — Grade VIII

Automotive Body and Fender Repair, N.B. — 30 Lessons — Fee $30
Prerequisite — Grade VIII

Diesel Engines, B.C. — 20 Lessons — Fee $12
Prerequisite — A knowledge of operation of the gasoline engine

Moteurs d'automobile, (P.Q.) — 20 Lessons — Fee $15
Prerequisite — Grade IX or equivalent

Électricité appliquée à l'automobile, (P.Q.) — 15 Lessons — Fee $15
Prerequisite — Grade IX or equivalent

Moteurs diesel, (P.Q.) — 20 Lessons — Fee $15
Prerequisite — Knowledge of internal combustion engines

For further information write to:

Correspondence Courses Branch,
Department of Education,
206 Huron Street,
Toronto 5, Ontario.

Director of High School Correspondence Instruction,
Department of Education,
Victoria, B.C.

Correspondence Courses,
Department of Vocational Education,
Fredericton, N.B.

Service des Cours par correspondance,
506 est, rue Sainte-Catherine,
Montreal 24 (P.Q.).

LOCAL INFORMATION

CANADIAN OCCUPATIONS FILMSTRIPS

The Department of Labour has prepared, to date, the following occupational filmstrips in collaboration with the National Film Board. A manual has been prepared as an accompaniment to each filmstrip. These may be purchased from the National Film Board, Box 6100, Montreal, or from any one of its regional offices.

Plumber, Pipefitter and Steamfitter
Careers in the Engineering Profession
The Social Worker
Technical Occupations in Radio and Electronics
Bricklayer and Stone-Mason
Printing Trades
Careers in Natural Science
Careers in Home Economics
Motor Vehicle Mechanic
Mining Occupations
Draughtsman
Careers in Construction
Sheet Metal Workers
Machine Shop Occupations
Careers in Meteorology
Medical Laboratory Technologist (in colour)
Teacher (in colour)

DEPARTMENT OF LABOUR

Economics and Research Branch

CANADA, 1959

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CANADIAN OCCUPATIONS

MOTOR VEHICLE MECHANIC

★

MONOGRAPH 10

REVISED 1957

DEPARTMENT OF LABOUR, CANADA

CANADIAN OCCUPATIONS

★

MOTOR VEHICLE MECHANIC

MONOGRAPH 10

REVISED 1957

HON. MILTON F. GREGG, V.C., MINISTER

A. H. BROWN, DEPUTY MINISTER

DEPARTMENT OF LABOUR, CANADA

PRINTED IN CANADA

45

Price: 10 cents

FOREWORD

During recent years there has been a steadily increasing demand for up-to-date information on occupations.

This demand comes from youth faced with the need of choosing an occupation and of selecting the type of training required; from parents, teachers and other counsellors; from workers shifting to other occupations; from employment service officers; from directors of personnel and union officials, and from other quarters.

This series of monographs and an accompanying series of pamphlets, the latter containing similar information in a condensed form, are attempts to meet this demand. These publications are designed for general use and cover a wide range of occupations, including professions. They indicate, among other things, the nature of the occupation or group of occupations, entrance and training requirements, working conditions and opportunities in each.

The staff of the Occupational Analysis Section has prepared this series with the generous assistance of representatives of management, trade unions, and professional associations. The cooperation of the Unemployment Insurance Commission, the Vocational Training Branch of the Department of Labour, and the Dominion Bureau of Statistics is gratefully acknowledged.

Acknowledgment is also made of the assistance obtained from numerous publications on occupations prepared in Canada and in other countries.

DIRECTOR,
Economics and Research Branch,
Department of Labour.

January 1957.

MOTOR VEHICLE MECHANIC

Photo: N.F.B.

The Motor Vehicle Mechanic Performs an Essential Public Service

HISTORY AND IMPORTANCE

The rapid development of motor vehicles as an integral part of modern living has made the motor vehicle mechanic an indispensable member of the community. There are about four million motor vehicles being operated on Canadian highways today. The army of mechanics servicing these vehicles is estimated to number well over 64,000, yet there is a shortage of qualified men in the trade. Working in a network of 25,000 garages that spreads from coast to coast, mechanics may be found in practically all sections of the country.

The development of the motor vehicle itself is an exciting chapter in human history and we wonder if the early inventors

ever dreamed of the impact that their "horseless carriage" would have on society in years to come.

A Frenchman named Cugnot built the first motor vehicle, which was steam powered, in 1770. However, it was not until 1888 that Serpollet produced the first boiler which was a practical success for use in a steam-driven car.

The use of steam power in motor vehicles was doomed when, in 1867, Otto invented an internal combustion engine that burned illuminating gas and Daimler, in 1884, patented a gasoline engine that was similar in its essential features to the modern four-cycle engine.

By 1900, motor buses were already running in London, and inventors in all industrialized countries were working on improvements in cars, some of which developed into the now familiar gear-shifts, drive-shafts, differentials, ignition systems, steering gear, lighting systems and the countless details that make up the modern car.

Although the motor vehicle was born in Europe, the problem of economical mass production was solved in the United States by Henry Ford and his competitors. Using assembly line methods, it was possible to produce in quantity vehicles which previously had been largely custom jobs, individually built. Thus the popular demand for a low-priced car was met, and by the outbreak of the First World War, automobiles were becoming commonplace.

The motor vehicle quickly became an essential feature of everyday life as the internal combustion engine proved itself to be a convenient, economical and versatile source of power. The development of the truck, the tractor-trailer, the passenger bus, the farm tractor, the bulldozer, and other mechanized equipment followed rapidly.

The manufacture of motor vehicles and motor vehicle parts is now one of Canada's major industries. Total production in 1953, a peak year, amounted in value to over $835,000,000. The number of vehicles produced that year exceeded 480,000.

Although the early automobiles were far less complex than those of today, they broke down frequently, and repairs had to be made by local handymen, machinists, blacksmiths or bicycle re-

pairmen. As the number of cars increased, the demand for motor vehicle mechanics grew, and garages, staffed by trained men, began to make their appearance.

In the early days of the automobile, and for some time afterwards, training in this trade was rather haphazard. The best mechanics were usually men who had trained as machinists and applied their knowledge to the internal-combustion engine. Other motor mechanics acquired their skill by working on cars in a garage, either alone or as a helper.

A more systematic and broader training was necessitated as motor vehicles became more varied, more advanced in design, and were made to finer tolerances. The development of complex testing equipment and tools, which made possible a greater refinement of adjustment, also added to the need for a more comprehensive system of training.

FIELD AND NATURE OF THE WORK

General Definition

Motor vehicle mechanics are skilled workers who adjust, repair or replace worn or damaged mechanical, electrical and body parts of passenger cars, trucks, buses, motorcycles, tractors and other internal-combustion powered vehicles. For the purposes of this monograph, the term "automobile mechanic" will be used synonymously with that of "motor vehicle mechanic" or "motor mechanic".

There are two main groups of motor vehicle mechanics: *general automobile mechanics,* who are fully skilled in general repair work, and *specialists,* who are also fully skilled in general repair work but who specialize in one or more aspects of the work —e.g. *automobile electrician, brake repairman, wheel alignment mechanic, motor* or *engine mechanic.*

Although a *body and fender mechanic* is a motor vehicle mechanic, he does not require a knowledge of the principles of the internal-combustion engine, nor is he concerned with the other mechanical or electrical parts of the motor vehicle. His work is separate from that of the general automobile mechanic and consists mainly of repairs to fenders, door panels and roof tops, and

calls for skill in sheet metal work, welding and painting. In some provinces, body and fender work has become a separate apprenticeable trade.

Automobile mechanics may also work on diesel-powered motor vehicles. Such mechanics require additional training in the principles of the diesel engine, its maintenance and repair.

Farm vehicles, especially tractors, and earth-moving equipment such as bulldozers, which may be either gasoline or diesel-powered, are also repaired by motor vehicle mechanics.

The automobile upholsterer does not come within the classification of automobile mechanic. As a rule, difficult upholstery or trimming work is done by a regular upholstering establishment, simpler work by the body and fender man.

Field of Work

The majority of motor vehicle mechanics are employed in general repair garages, in the service departments of automobile and truck dealers, and in specialty garages. In the large dealer shops and in some independent repair garages, where the work is departmentalized, it is customary for mechanics to specialize. Men employed in such shops may, however, be shifted from one department to another, depending on the extent and kind of work on hand, so that the mechanic's duties may be more varied in such establishments than in specialty garages. Specialty garages usually concentrate upon one particular service, such as carburetor and ignition repair, body and fender repair, and radiator repair.

Many large firms in the commercial, manufacturing, construction and transportation fields operate garages to service their own fleets of cars, trucks and other motor vehicles. Examples of these are department stores, food distributors, delivery firms, construction contractors, bus lines, taxi companies, etc. Governments — federal, provincial, and especially municipal — also operate garages for all types of publicly owned motor vehicles.

There are many types of internal-combustion engines used in petroleum exploration, pipe-line construction, and oil transportation, which call for the services of skilled automotive mechanics.

A small number of skilled mechanics are employed by automobile service stations. Some of these service stations do either

general or specialized repairs (usually on passenger cars and light trucks), but many do only minor adjustments and repairs, or install auto accessories, so that the need for the skilled mechanic in this field is not great.

Automobile mechanics are also employed by automobile and truck manufacturing concerns, where they repair and replace defective motors and parts.

Duties

General Automotive Mechanic

Determines either by personal inspection, questioning the driver, or by use of special instruments and mechanical devices, the cause of faulty operation; disassembles parts of the vehicle, such as motor, transmission, clutch, differential, steering mechanism and electrical system, using necessary hand tools and specialized equipment; repairs or replaces worn or damaged parts; reassembles the parts in correct arrangement, making necessary adjustments for alignment or clearance; and performs other related repair tasks to place the vehicle in operative condition.

The duties of the general automobile mechanic vary according to the type of motor vehicle usually serviced in a particular establishment. For example, he may work on automobiles and light trucks, heavy trucks, buses, and other vehicles both gasoline and diesel-powered.

In addition to the duties already mentioned, the heavy-truck and bus mechanic maintains and repairs air and hydraulic couplings, and other connective mechanisms; air, electric and hydraulic brake systems; auxiliary mechanisms including winches, pumps, dumping or lifting apparatus, refrigerating equipment, trailers and trailer equipment, etc.

The diesel-engine automobile mechanic performs repair and overhaul work similar to that of the general automotive mechanic, on trucks, buses, etc., that are equipped with diesel engines. In addition, he repairs and maintains fuel injection systems, fuel or spray nozzles, fuel-transfer or oil-supply pump and governor, and times the fuel injection pump.

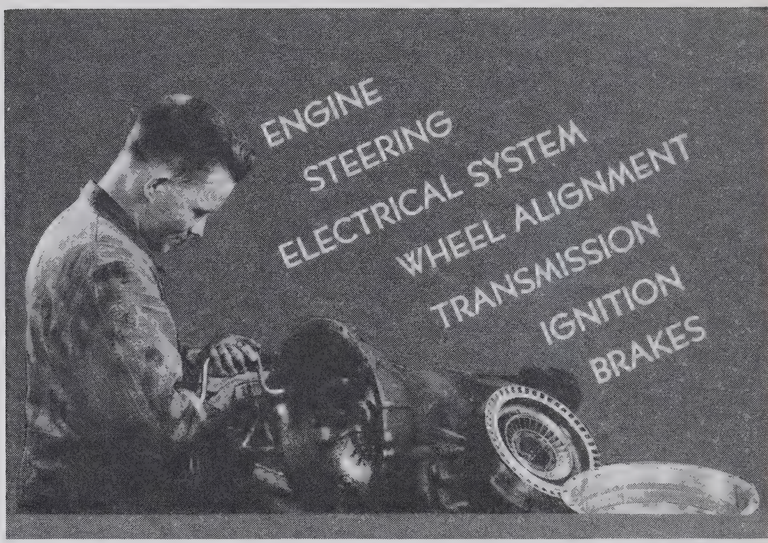

Photo: N.F.B.

The Journeyman May Specialize.

Specialty Automotive Mechanics

As mentioned previously, these workers are usually general automotive mechanics who have specialized in one particular phase of repair. They are usually employed in departmentalized or specialty garages, and at slack periods may be shifted from one phase of the work to another. Some of the specializations, with their particular duties, are as follows:

Automobile Electrician — repairs and installs ignition systems, starters, coils, generators, condensers, distributors, panel instruments, and other electrical equipment on various types of motor vehicles, using necessary hand tools and mechanical and electrical testing devices. May do motor tune-up, and, if qualified, may test, repair and install automobile radios and aerials.

Brake Repairman — tests, overhauls, and adjusts mechanical, electrical, air and hydraulic brake systems on various

types of motor vehicles. Usually operates a brake-drum lathe to re-surface scored brake drums. May repair and install shock absorbers and leaf or coil springs.

Wheel Alignment Mechanic — tests for and corrects alignment of automobile, truck, bus and tractor frames, wheels, steering-gear and front axle assembly, using necessary hand tools and mechanical testing or corrective devices. May weld, bend or otherwise straighten axles, and repair or install shock absorbers and springs.

Automobile Mechanic, Motor — repairs and installs motors in all types of motor vehicles. May work entirely at a bench, doing inspection and adjustment of motors.

Automobile Radiator Man — tests, cleans and repairs automobile, truck, bus and tractor radiators, pumps and other parts of cooling system. Work usually involves testing radiator, motor block, hoses, and pumps for leaks; checking, repairing or installing hoses, thermostats and pumps; soldering radiator cores and cleaning entire cooling system.

Auto Body Mechanic — repairs or replaces damaged fenders, door panels and roof tops: hammers out dents; smooths hammered area by filing or by grinding or sanding it with small electric grinding or sanding wheel. May fill badly dented areas with solder if hammering and filing does not remove dents, and file solder until area is smooth and blends with adjacent surface. May weld breaks in body metal and smooth the rough weld with a file. Prepares surface properly for painting. May paint damaged part or whole vehicle, using a spray gun.

Although the automobile radiator man and the auto body mechanic are considered to be specialists, they are not usually all-round mechanics.

QUALIFICATIONS

The normal entrance age for apprenticeship in this trade varies from 16 to about 21. In British Columbia apprenticeship regulations stipulate 15 as the minimum entrance age; in Ontario and Manitoba the maximum age is set at 21, and in Quebec 25, although older applicants may be approved in some cases. No maxi-

mum age is set in the case of Newfoundland, Nova Scotia, New Brunswick, Saskatchewan, Alberta and British Columbia.

The academic requirements called for by apprenticeship regulations are not high. There is no definite minimum specified in Alberta or British Columbia. In the other provinces, the minimum requirements are: Quebec, grade 6; Ontario and Saskatchewan, grade 8; New Brunswick and Manitoba, grade 9; Newfoundland and Nova Scotia, grade 10. Educational requirements for auto body mechanics are set at grade 8 in New Brunswick and Saskatchewan.

A person considering this trade should have an aptitude for, and an active interest in, working with his hands and with mechanical things. A pleasing personality, and the ability to deal with the public and fellow employees are important qualifications for the mechanic who aspires to the position of service manager.

Because of the physical movements involved in the occupation — a great deal of standing, reaching, lifting, carrying, pushing, pulling, handling and fingering; a moderate amount of walking, turning, stooping, crouching, kneeling and sitting; and a small amount of balancing and climbing — the motor vehicle mechanic should be physically strong and agile, have good health and endurance, fairly good eyesight (with or without correction), and fairly good hearing. The occupation also calls for strong arms and legs and a good degree of dexterity in hand and finger movement. Some employers require that workers pass a physical examination before they are hired.

The trade of motor vehicle mechanic does provide some opportunity for certain handicapped individuals. Workers with finger disabilities, blindness in one eye, poor hearing, flat feet or fallen arches, are not barred from employment. Poor eyesight, missing limbs and certain pulmonary ailments are handicaps in gaining employment. There are instances, not too common, of successful workers in this occupation who have the use of only one leg or have limited use of both legs.

PREPARATION AND TRAINING

One interested in entering this trade would do well to get as much secondary school training as possible, preferably at a technical or vocational school offering a course in motor vehicle repair

work. The practical experience and the theoretical knowledge gained from such a course, not only in motor mechanics, but in such general subjects as mathematics, chemistry and physics, provide a valuable preparation for apprenticeship. The student who completes such a course, or who has taken a good part of it, will be more readily accepted as an apprentice than one who has not had any preliminary training. Another advantage is that a time credit is usually allowed for training at a recognized vocational school and the term of apprenticeship correspondingly shortened.

The majority of Canadian provinces, recognizing the need for systematic training in this trade, have established apprenticeship programs for the training of motor vehicle mechanics. In addition, some provinces have established pre-apprenticeship courses.

Mention has been made of the desirability of a technical or vocational school course as preparation for apprenticeship. The same can be said for provincial pre-apprenticeship courses. The plan calls for a trainee to attend full-time classes at one of the provincial centres for a period of about six months, receiving a weekly allowance during the training period. At the end of the course, trade tests are given and the trainee rated according to his proficiency.

At the present time, pre-apprenticeship courses for motor mechanics are being conducted in Newfoundland, Nova Scotia, New Brunswick, Manitoba and Alberta. In the case of Alberta, a trainee must first become indentured as an apprentice before he is eligible for such a course. This is not required in the other four provinces.

Apprenticeship Training

One can become an all-round mechanic in one of two ways, either as an apprentice or as a helper. Training as an apprentice is the more desirable for several reasons: there is an agreement between the employer and the apprentice which provides for a progressive and thorough training; in the majority of provinces apprenticeship training is controlled by provincial Apprenticeship Boards (in Quebec, by local Apprenticeship Commissions); also, a minimum wage rate, which is on a progressive scale, is laid down by the apprenticeship authorities. These factors do not apply in the case of the helper. Despite this, it is only fair to say that

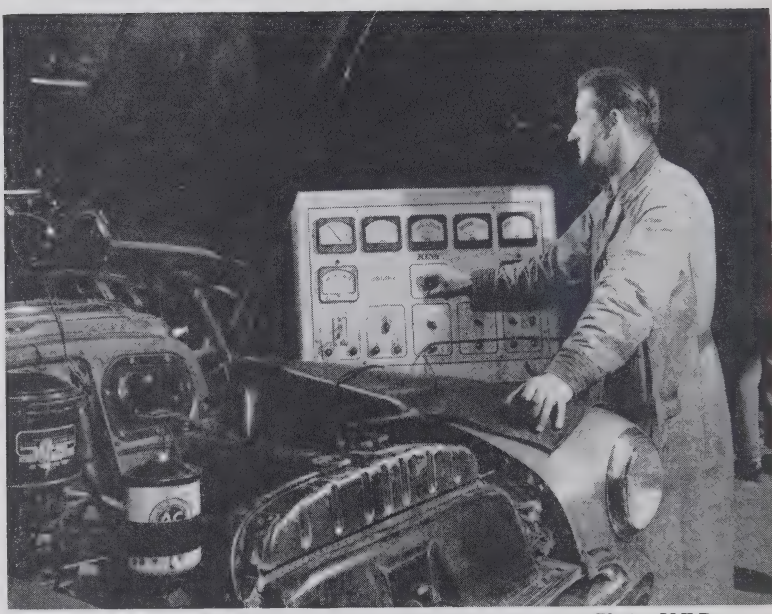

Photo: N.F.B.

The Apprentice Learns to Diagnose Trouble Scientifically.

helpers do, in many instances, get an all-round training in the trade. Much depends on the employer.

Apprentice training lasts for four years in some provinces, five years in others, each year representing a specific number of work-hours. Many think this training period is unnecessarily prolonged. It is held by the trade, however, that the stipulated term does not only represent the time required to learn the various operations, but also the period necessary for the apprentice to encounter the various jobs a number of times and to be able to do the work in a reasonable length of time.

The term of apprenticeship may be reduced by previous experience in the field, training in related subjects in technical or vocational schools, or pre-apprenticeship courses.

The apprentice learns by working under the supervision of a qualified motor mechanic. Starting with simple tasks in the garage or shop, he follows a progressive program of work in accordance with a suggested schedule from the apprenticeship authorities. Later he learns to master the intricacies of complex parts, such as carburetors and transmissions. In some garages, the repair of automotive farm equipment, such as tractors and combines, may form a large part of the day's work. Apprentices working in these garages will acquire considerable experience on this type of equipment. In garages equipped to handle the maintenance and repair of diesel-powered equipment, the apprentice may learn this specialized branch of the trade along with general automotive work.

To round out on-the-job experience, the apprentice will usually be required to take classroom instruction at a technical or vocational school for periods ranging from six to twelve weeks per year, depending on the province. The apprentice usually receives a weekly training allowance while attending classes. In class, the apprentice learns the reasons for certain shop practices. He also learns the mechanical principles behind the operation of internal-combustion engines and other parts of motor vehicles.

The following shows the length of the apprenticeship period and the full-time classroom instruction schemes in effect in the various provinces in which motor vehicle repair is a designated trade. In some provinces, where it is difficult for apprentices to attend full-time day classes, the equivalent may be obtained in evening classes.

Newfoundland	**Four years,**	first year	— 8 weeks;
		second year	— 6 weeks;
		third year	— 3 weeks;
		fourth year	— 3 weeks.
Nova Scotia	**Four years,**	first year	— 10 weeks;
		next two years	— 4 weeks per year;
		fourth year	— 5 weeks.
New Brunswick	**Four years,**	up to 3 months per year.	
Ontario	**Five years,**	second year	— 10 weeks;
		fourth year	— 10 weeks.
Manitoba	**Five years,**	Junior	— 6 weeks;
		Intermediate	— 6 weeks;
		Senior	— 4 weeks.

Saskatchewan	**Five years,**	first year	— 8 weeks;
		second year	— 8 weeks;
		third year	— 8 weeks;
		fifth year	— 7 weeks.
Alberta	**Four years,**	first year	— 8 weeks;
		second year	— 8 weeks;
		third year	— 6 weeks;
		fourth year	— 6 weeks.
British Columbia	**Four years,**	4 weeks per year.	

In a trade such as motor vehicle repair, home study courses are useful supplements to, but not substitutes for, practical training. Correspondence courses in auto and diesel mechanics are available from the Departments of Education in Nova Scotia, Quebec, Ontario and British Columbia. These courses, listed in Appendix I, are available to residents of all provinces and are reasonably priced. The courses prepared by the province of Quebec are in French.

When an apprentice has passed his final tests, he receives his journeyman's papers, showing that he has served his time in the trade.

Some capital investment is necessary, as every mechanic must have his own tool kit. The amount invested will vary. A general mechanic may spend from $100 to $150 on his initial kit and then add to it as he is able. Employers frequently assist the apprentice in financing tool purchases.

For the automobile mechanic, training is a continuous process. The many innovations, models and methods in the field, make it necessary for the worker to spend considerable time studying trade books or taking special courses. Some employers arrange for regular refresher courses for their employees.

ENTRY INTO THE OCCUPATION

The National Employment Service, working in co-operation with school placement officers and officials of the Apprenticeship Branches of the provincial Departments of Labour, assists young men in becoming established in training as apprentices.

Many young men get a start in the trade through personal contacts or by working in a garage or service station after school

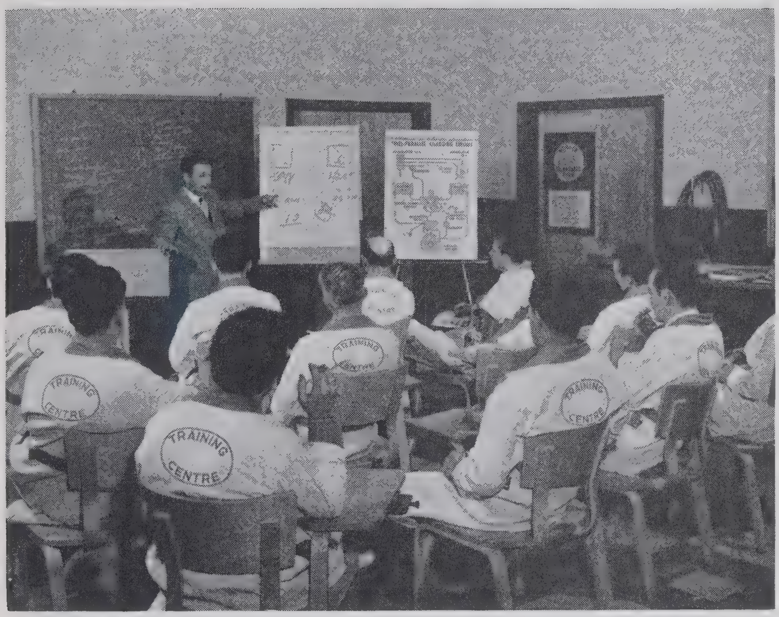

Photo: N.F.B.

Refresher Courses Keep Mechanics Up to Date.

hours or during vacations. Also, the daily newspapers regularly carry advertisements for experienced motor mechanics and apprentices.

EARNINGS

Wages paid to motor mechanics vary widely, influenced as they are by such factors as locality, type of garage, skill level of the worker, and the length of the work-week. Another factor that makes for differences is that mechanics are mainly paid in one of two ways — either on a flat-rate or piece-work basis, or by the hour.

The flat-rate or piece-work scheme works as follows: the garage sets a definite time for the completion of each type of repair (usually following the times suggested by the manufacturer).

For example, a certain repair job may be fixed at five hours. The customer is charged so much per hour (commonly $3.00 to $3.50), the mechanic receiving 40 to 45 per cent of the hourly charge as his share. If the mechanic completes the job in less than five hours, he still gets paid for five hours' work. The repair times are set so that a good mechanic usually completes a job within the time limit. Under this system, the mechanic must be accurate, as well as fast, since he is not paid for work that has to be redone. Higher rates for overtime are not common under the flat-rate scheme. In some garages, workers are assured of a minimum weekly wage in order to take care of a temporary decrease in work.

The hourly rate system of pay is common to municipal and private transportation garages — bus, railway, taxi and trucking. Workers are paid a fixed amount per hour, whether or not there is any work. Earnings under this system, however, may not be as high as under the flat-rate scheme in the case of experienced men. Time-and-a-half for overtime is paid in many cases.

The Apprenticeship Boards of the various provinces set the minimum wage rate for apprentices, calculated as a percentage of the prevailing rate paid the journeymen in the garage. Increases are granted every 6 months in some provinces and every 12 months in others.

Although pension schemes are by no means general, a number of garages have set up contributory plans for their employees and these, plus other benefits, are factors in earnings.

The following table gives wage rate information for automobile mechanics in various localities as at October 1955. The ranges shown constitute the middle 80 per cent of rates reported. Actual earnings are affected by factors other than wage rates, such as hours worked per week and weeks worked per year. For current wage information, the reader should consult local National Employment Service offices, employers, or Wage Rates and Hours of Labour in Canada, *published annually by the Department of Labour, Canada.*

WAGE RATES AND HOURS OF LABOUR IN AUTO REPAIR AND GARAGES[1], October 1955.

Occupation and Locality	Standard Hours per Week	Wage Rate per Hour (time work)		Straight-time Earnings per Hour (piece or incentive work)	
		Average	Predominant Range	Average	Predominant Range
Automobile Mechanic		$	$	$	$
Canada	—	1.49	—	1.59	—
Newfoundland	—	1.33	—	—	—
St. John's	50	1.29	1.12-1.40	—	—
Nova Scotia	—	1.23	—	1.38	—
Halifax	45-50	1.29	1.25-1.40	—	—
Sydney	40-44	1.35	1.18-1.41	—	—
New Brunswick	—	1.14	—	—	—
Moncton	43½	1.32	1.30-1.40	—	—
Saint John	47-50	1.07	1.00-1.20	—	—
Quebec	—	1.35	—	1.53	—
Chicoutimi	49	1.45	1.30-1.50	—	—
Hull	44-54	—	—	1.78	1.40-2.02
Montreal	45-60	1.38	1.20-1.54	1.45	1.16-1.90
Quebec	44-60	1.42	1.23-1.45	—	—
Sherbrooke	49-50	1.38	1.25-1.40	—	—
Three Rivers	49-54	1.08	.93-1.30	—	—
Ontario	—	1.49	—	1.62	—
Brantford	46½-49	1.32	1.25-1.40	—	—
Fort William	40	—	—	1.65	—
Hamilton	48-50	1.55	1.37-1.74	1.44	—
Kingston	48-49	1.41	1.40-1.45	—	—
Kirkland Lake	48	1.39	1.25-1.50	—	—
Kitchener	45-49	1.38	.96-1.45	—	—
London	47-48	1.37	1.30-1.50	—	—

1. Auto Repair and Garages — Establishments primarily engaged in the repair of automobiles, motor trucks, tires and in the live storage of automobiles for the general public. Establishments owned and operated by concerns for their own use and not offering their services to the general public are not included. Filling stations and service stations which are primarily engaged in retail selling of gasoline and oil are not included.

Source: *Wage Rates and Hours of Labour in Canada,* October 1955, Department of Labour, Canada.

WAGE RATES AND HOURS OF LABOUR (Continued)

Occupation and Locality	Standard Hours per Week	Wage Rate per Hour (time work)		Straight-time Earnings per Hour (piece or incentive work)	
		Average	Predominant Range	Average	Predominant Range
Automobile Mechanic		$	$	$	$
Ottawa	44-49	1.35	1.20-1.46	1.48	1.15-1.70
Owen Sound	49	1.30	—	—	—
Peterborough	46½-48	1.37	1.25-1.43	—	—
St. Catharines	48-49	1.46	1.38-1.55	—	—
Sudbury	48-49	—	—	1.76	1.58-1.93
Timmins	48	1.45	1.40-1.50	—	—
Toronto	42½-49	1.59	1.40-1.80	1.70	1.49-1.87
Welland	48	1.49	—	—	—
Windsor	48-49	—	—	1.86	1.56-2.20
Manitoba	—	1.26	—	1.50	—
Winnipeg	40-54	1.31	1.02-1.58	1.52	1.12-1.94
Brandon	48	—	—	1.43	1.27-1.73
Saskatchewan	—	1.44	—	1.52	—
Moose Jaw	48	1.45	1.35-1.50	1.50	—
Regina	46½-48	1.45	1.12-1.61	—	—
Saskatoon	44	—	—	1.69	1.59-2.27
Alberta	—	1.61	—	1.70	—
Calgary	42½-44½	1.65	1.60-1.73	—	—
Edmonton	44-48	1.63	1.50-1.75	—	—
Lethbridge	44	1.60	1.55-1.63	—	—
Medicine Hat	44	1.49	—	—	—
British Columbia	—	1.81	—	1.81	—
Vancouver	40-42½	1.84	1.79-1.85	—	—
Victoria	44	1.75	1.60-1.79	—	—

WORKING CONDITIONS

Working conditions for motor mechanics vary according to the type of garage. On the one hand there is the modern, well planned establishment, which is well lighted, ventilated and heated, and has lunch-room, locker and washroom facilities. The flow of work is

Photo: N.F.B.

The Journeyman May Become a Foreman.

organized and facilitated by many time and labour-saving devices. On the other hand, there are still many shops that have poor lighting, heating and ventilation, and where the mechanic has to work in cramped space and with fewer labour-saving devices. The increased floor space of large garages has eliminated much of the outdoor repair work on vehicles, but this is not possible in the case of many small firms.

ADVANCEMENT

The usual line of advancement for motor mechanics is from apprentice to journeyman, journeyman to foreman, and foreman to service manager or superintendent. Beyond the journeyman stage, advancement is necessarily slow because of the small number of supervisory positions.

Going into business on one's own is another possibility for the experienced mechanic who has sufficient capital and a good knowledge of business management. The amount of capital required depends entirely on the size and type of garage planned.

RELATED OCCUPATIONS

Occupations that are concerned with the assembly, repair and maintenance of internal-combustion engines are all closely related to that of the motor mechanic. Some of these are:

- Aircraft-Engine Mechanic (air transportation; aircraft manufacturing)
- Aircraft-Engine Assembler (air transportation; aircraft manufacturing)
- Engine-Service Mechanic (air transportation)
- Engine Tester (air transportation; aircraft manufacturing)
- Diesel Mechanic (any industry)
- Motor and Chassis Inspector (auto manufacturing)
- Experimental Mechanic (auto manufacturing)

Another closely related occupation is that of motor vehicle mechanic instructor in a technical, vocational or trade school.

The wholesale and retail selling of automotive parts and accessories, and the sale of cars, although not closely related, are other potential fields for the motor mechanic.

ADVANTAGES AND DISADVANTAGES

The work of the motor vehicle mechanic is interesting and varied, and, as in the case of all technical skills, affords him the satisfaction of seeing the concrete results of his efforts.

Because the trade is practised in all provinces in Canada, the mechanic, if the need arises, can move about and still remain within the trade.

For the skilled mechanic, there is always the possibility of advancing to supervisory positions or establishing his own business.

Although there is some seasonal variation in employment, it is generally of a minor nature. This is especially true in the towns and cities where year-round operation of motor vehicles is com-

mon. During business recessions employment is more stable than in many other trades, especially for skilled mechanics.

Some of the disadvantages are that much of the work is done under unpleasant conditions — dirt, grease, oil, fumes, and at times wet and cold. There is a definite trend, however, towards improved working conditions.

There are certain occupational hazards. Accidents may occur in the use of hoisting equipment, machine tools and inflammable materials, but these can all be avoided with proper care. Health hazards due to fumes, wet and cold have been greatly reduced in the case of the well heated and ventilated modern garage, but such hazards still exist in many other shops.

LABOUR ORGANIZATION

Motor mechanics may belong to craft or industrial unions, the latter especially where their trade is practised in connection with some industry or service. The very nature of their employment — two to three in a garage in scattered locations — has made it difficult to organize the trade. Consequently, many of the benefits resulting from such organization are lacking.

TRENDS

Growth

By 1951, the number of motor vehicle mechanics had reached a total of 64,328, an increase of 60 per cent over the estimated 40,000 in 1941. Over this period, however, the growth in the number of mechanics failed to keep pace with the rise in the number of motor vehicle registrations, which showed an increase of over 80 per cent.

Between 1951 and 1955, motor vehicle registrations increased by a further 37.5 per cent, whereas the number of apprentice mechanics (excluding those in Quebec) rose by only 12 per cent. The supply situation for mechanics would have been quite serious had it not been for immigration — some 9,000 immigrants, who were classified as automobile mechanics, came into Canada during this period. Immigration, however, cannot be expected to continue to contribute to the supply of mechanics at the same high level —

from a high of 2,900 in 1951, the number of immigrant mechanics had declined to 850 in 1955.

If, as expected, the number of motor vehicles continues to increase at a rapid rate, the likelihood is that the shortage of mechanics will, in the light of the immigration picture, be felt more heavily from now on.

Distribution of Mechanics

Ontario and Quebec together accounted for 60 per cent of all motor vehicle mechanics in Canada in 1951. Among the western provinces, British Columbia led with 9.3 per cent, followed by Alberta with 8.7 per cent. It is interesting to note, though, that each of the western provinces had a higher proportion of mechanics per 1,000 population than any of the other provinces. This is a reflection of proportionately higher motor vehicle registrations in the western provinces.

DISTRIBUTION OF MOTOR VEHICLE MECHANICS BY PROVINCE, 1951.

	Number	Per Cent	Number per 1,000 of Population
Canada	64,328	100.0	4.6
Newfoundland	872	1.4	2.4
Prince Edward Island	397	.6	4.0
Nova Scotia	2,427	3.8	3.8
New Brunswick	2,033	3.2	4.0
Quebec	15,621	24.2	3.8
Ontario	22,913	35.5	5.0
Manitoba	4,108	6.4	5.3
Saskatchewan	4,418	6.9	5.3
Alberta	5,579	8.7	5.9
British Columbia	5,960	9.3	5.1

Source: 1951 Census of Canada, D.B.S.

Service garages are the largest employers of automobile mechanics, followed by wholesale and retail trade.

Age Groups

In 1951, motor vehicle mechanics fell into the following age groups: age 24 and under — 20.2 per cent; between 25 and 54 — 74.1 per cent; 55 and over — 5.6 per cent. The 55-and-over

age group decreased from an estimated 7 per cent in 1941 to 5.6 per cent in 1951. Because of the very low proportion of mechanics in the older age groups, it can be expected that future employment opportunities will be more dependent on expansion of the trade rather than on turnover owing to deaths and retirements.

Length of Work Year

There has been, in recent years, very little seasonal unemployment in this trade. In 1941, about 60 per cent of all wage-earning motor mechanics had fifty or more weeks of employment in the year; by 1951, the proportion had risen to 75 per cent.

The fact that highways and secondary roads are kept open in all seasons has been a factor in maintaining a reasonably high level of work in the servicing and repair fields. Highway freight and passenger traffic is now on a year-round basis. There may be some falling-off in the use of automobiles in winter in urban and suburban areas, where alternative public passenger service exists, and also because of the reduction in long-distance pleasure and holiday driving. This is, however, more than compensated for by the increased servicing required by winter-driven vehicles.

Employment Prospects

A comparison of vacancies in this trade and registrations for employment as listed by the National Employment Service, reveals that motor vehicle mechanics are in short supply in Canada as a whole, and in the Quebec, Ontario, Prairie and Pacific regions in particular.

Employment prospects for the well trained mechanic are very good. Many factors point to an increasing need for the services of skilled motor mechanics.

The greatest single factor is the tremendous increase in the number of registered automobiles, which is expected to reach 5 million by 1960.

Other factors favorable to the motor mechanic are the increasing mechanization of farm operations and the use of diesel power in industry. The development of natural resources, such as iron in north-western Ontario and in Quebec and Labrador, oil in

Alberta and Saskatchewan, and the expanding construction industry, will require more tracked vehicles, trucks and other powered equipment.

A rising standard of living with more leisure time permits greater use of the automobile for pleasure driving. The completion of the Trans-Canada highway and development of other arterial systems should lead to an increase in tourist travel, bus travel and long-distance truck hauling.

The automobile is so essential an item in everyday life, to at least two generations, that it is one of the last expenses to be foregone when income is reduced. If economic conditions should reduce the sale of new cars it is certain that the older models would be kept in use longer, making the mechanic's services even more necessary.

Although employment prospects for motor vehicle mechanics are good, this applies mainly to the qualified journeyman. If competition for employment becomes keen, the position of the partially trained man will become less secure.

SUGGESTED READING

The Guidance Centre, Ontario College of Education, Toronto, Monograph, *Automobile Mechanic* (1954).

General Motors Products of Canada Limited, Oshawa, Ontario, Booklets, *Key to Careers in the Retail Automotive Business,* and *Automotive Jobs in Yourtown.*

Michigan State Employment Service, Detroit, "Occupational Guide" series, No. 30, *Automobile and Truck Mechanics* (1954).

APPENDIX 1

The catalogue "Canadian Vocational Correspondence Courses" lists 123 home study courses in various vocational subjects and can be obtained by writing to your provincial Department of Education or to the Vocational Training Branch, Department of Labour, Ottawa.

The following courses are included in this catalogue:

Automotive Mechanics I, Ontario — 20 Lessons — Fee $10.
Prerequisite — Grade VIII Mathematics.

Automobile Engines (Canadian Legion), Quebec — 20 Lessons — Fee $10.
Prerequisite — Grade IX or equivalent.

Auto Mechanics I, B.C. — 20 Lessons — Fee $10.
Prerequisite — Garage experience or Grade X Mathematics and Science.

Auto Mechanics II, B.C. — 20 Lessons — Fee $10.
Prerequisite — Automotive Mechanics I or equivalent.

Automobiles — Gasoline — Part I, N.S. — 10 Lessons — Fee $11.40. Text $3.80 — "Automotive Service" Vol. 1 — Kuns.
Prerequisite — Grade IX or equivalent preferable. Grade VII or equivalent acceptable.

Diesel Engines, B.C. — 20 Lessons — Fee $10.
Prerequisite — A knowledge of the operation of the gasoline engine.

Diesel Engines, Quebec — 20 Lessons — Fee $10.
Prerequisite — A knowledge of the operation of the gasoline engine.

Those interested in further information should write to one of the following provincial officials:

The Supervisor,
Correspondence Study Branch,
Box 221, Halifax, Nova Scotia.

The Director,
Correspondence Course Bureau,
506 St. Catherine Street East,
Montreal 24, Quebec.

The Director,
Correspondence Courses Branch,
Department of Education,
Toronto 5, Ontario.

The Director,
High School Correspondence Instruction,
Weiler Building,
Victoria, B.C.

LOCAL INFORMATION

LOCAL INFORMATION

LOCAL INFORMATION

"CANADIAN OCCUPATIONS" SERIES

Monographs and Pamphlets

The monographs listed below, accompanied by pamphlets, except in the case of numbers 12, 13 and 39, have been published to date.

(1) Carpenter
(2) Bricklayers and Stone-Masons
(3) Plasterer
(4) Painter
(5) Plumber, Pipe Fitter and Steam Fitter
(6) Sheet-Metal Worker
(7) Electrician
(8) Machinist and Machine Operators (Metal)
(9) Printing Trades
(10) Motor Vehicle Mechanic
(11) Optometrist
(12) Social Worker
(13) Lawyer
(14) Mining Occupations
(15) Foundry Workers
(16) Technical Occupations in Radio and Electronics
(17) Forge Shop Occupations
(18) Tool and Die Makers
(19) Railway Careers

Careers in Natural Science and Engineering: (20-35, one booklet)

(20) Agricultural Scientist
(21) Architect
(22) Biologist
(23) Chemist
(24) Geologist
(25) Physicist
(26) Aeronautical Engineer
(27) ——
(28) Chemical Engineer
(29) Civil Engineer
(30) Electrical Engineer
(31) Forest Engineer and Forest Scientist
(32) Mechanical Engineer
(33) Metallurgical Engineer
(34) Mining Engineer
(35) Petroleum Engineer

(36) Hospital Workers (Other than Professional)
(37) Draughtsman
(38) Welder
(39) Careers in Home Economics
(40) Occupations in the Aircraft Manufacturing Industry
(41) Careers in Construction

Filmstrips

The Department of Labour has prepared, to date, the following occupational filmstrips in collaboration with the National Film Board. A manual has been prepared as an accompaniment to each filmstrip. These may be purchased from the National Film Board, Box 6100, Montreal, or from any one of its regional offices.

Plumber, Pipefitter and Steamfitter
Careers in the Engineering Profession
The Social Worker
Technical Occupations in Radio and Electronics
Bricklayer and Stone-Mason
Printing Trades
Careers in Natural Science
Careers in Home Economics
Motor Vehicle Mechanic

DEPARTMENT OF LABOUR

Economics and Research Branch

CANADA, 1957

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Careers in Engineering	L43-2065
Careers in Natural Science	L43-2161
Careers in Drafting	L43-3763
Careers in Construction	L43-4164
Office Occupations	L43-4663
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THE QUEEN'S PRINTER
Ottawa, Canada

Front cover photographs by the National Film Board of Canada

Canadian Occupations

Monograph 10

MECHANICAL REPAIR OCCUPATIONS

Prepared
by the
Government of Canada

FIRST EDITION 1965

Note: Monograph No. 8, "Motor Vehicle Mechanic", has been withdrawn from circulation and the information included in this booklet.

Available by mail from the Queen's Printer, Ottawa,
and at the following Canadian Government bookshops:

OTTAWA
Daly Building, Corner Mackenzie and Rideau

TORONTO
Mackenzie Building, 36 Adelaide St. East

MONTREAL
Aeterna-Vie Building, 1182 St. Catherine St. West

WINNIPEG
Mall Center Bldg., 499 Portage Avenue

VANCOUVER
657 Granville Street

or through your bookseller

A deposit copy of this publication is also available
for reference in public libraries across Canada

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ROGER DUHAMEL, F.R.S.C.
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Ottawa, Canada
1965

FOREWORD

During recent years there has been a steadily increasing demand for Canadian occupational information. The demand comes from young people faced with the need of choosing an occupation and preparing for it; from parents, teachers and vocational guidance counsellors; from workers wishing to change their occupations; from employment service officers; from personnel directors and union officials; from prospective immigrants to Canada and from other quarters.

The CANADIAN OCCUPATIONS series of monographs is designed to help meet this demand. Each booklet describes, among other things, the nature of the occupation or groups of occupations, entrance and training requirements, working conditions and employment outlook.

The series has been prepared with the generous assistance of representatives of management, trade unions and professional associations. The co-operation of the Unemployment Insurance Commission, the Technical and Vocational Training Branch and the Dominion Bureau of Statistics is gratefully acknowledged.

Occupational information tends to become dated as a result of changes in economic conditions, in industrial technology and in wage and salary structure. Revision of outdated publications is a regular feature of the series.

This booklet was prepared and written by Miss Mary E. Stuart and William Coe of the Occupational Analysis Section.

We are greatly indebted to the many organizations and companies whose assistance made this monograph possible.

J. P. FRANCIS

May 1965

CONTENTS

CONTENTS—continued

MECHANICAL REPAIR OCCUPATIONS

HISTORY AND IMPORTANCE

Any attempts to trace the origin of the present-day, highly skilled workers who provide our repair and maintenance services would require a review of much of Canada's history for, as early as the turn of the 17th century, records indicate that Jean Talon imported craftsmen from the guilds of Europe to plant a long tradition of manual skills in the New World.

For many years, the skills practised were those necessary for the establishment and comfort of the settlers in a then-remote and uncompromising land. In small, craftsmen-operated shops, of which the blacksmith's shop is typical, articles of domestic utility, machinery for the grist mill and tannery, vehicles, agricultural implements and the many other items required to fill local needs were designed, forged, machined and fabricated into finished products.

Only part of the craftsman's time however was occupied with the manufacture of new products; although the settlers were competent handymen able to fix simple mechanical and other defects, often their equipment had to be returned to the local craftsman for the more difficult types of repair. Thus, between making a carriage wheel and casting a sugar pot, the craftsman would turn his hand to patching an oven door, machine a replacement part for a muzzle loader, grind and harden the blade of a scythe, or even forge a drive shaft for the village clock. This "customer-to-craftsman" relationship, possible because most of the machinery or mechanical equipment was made in local plants, was to prevail until the latter part of the 18th century.

The great inventions which distinguished the 18th and 19th centuries created a new society: development of the steam engine provided vast amounts of power to replace the handwork of the craftsman; many parts could now be made in large quantities and to such high standards of accuracy that they were interchangeable; and

specialists, skilled in one branch of manufacture such as design, forging or assembly made their appearance. To these specialists, a new group—the mechanics and repairmen—were soon to be added.

The turn of the 19th century marked Canada's birth as an industrial nation and many changes took place in manufacturing and marketing methods. With improvements in road transport, extension of the railroads to the West, and government policies, vast demands were created for agricultural and other mechanical equipment. To meet these demands, many of the smaller shops combined into large metal working plants or factories.

Movement of manufacturing from local shops to relatively distant plants considerably affected the old customer-to-craftsman relationship. Products were now supplied through retail outlets by shopkeepers without the skills and knowledge to service or repair the items they sold. In addition, much of the equipment produced in the factories had, by this time, become quite complicated, beyond the skill of the do-it-yourself handyman and frequently beyond that of general craftsmen. In consequence, manufactured products often had to be returned to distant plants for repair—a situation which, to some extent, exists today. This procedure was however time-consuming because of the then-inadequate transport facilities and retailers added interchangeable parts to their stock. The next step was the setting up of local service and repair facilities, either as part of the retailer's store or as separate shops.

The change from the horse-and-buggy to the automobile illustrates in many ways the growth of repair occupations. At the turn of the present century, all industrialized nations were working on improvements in road transport which have resulted in the now-familiar automobile. It was obvious that the average owner of one of these new-fangled inventions was unlikely to have sufficient skill to make adjustments or repairs so local handymen, carriage builders and other craftsmen opened up garages and began to undertake vehicle maintenance. As the number of vehicles grew, demands for repairmen also increased and garages staffed by craftsmen trained specifically in vehicle work made their appearance: with the advent of more powerful engines, automatic transmission systems, power steering and other refinements, vehicles increased in complexity,

general mechanics began to concentrate on one branch of vehicle repair and the specialist emerged.

In the pages which follow, a number of mechanical repair occupations are described which will appeal to readers who obtain personal satisfaction from working with their hands, with handtools and with machines. Although there is no need to be a great scholar, the occupations described also offer the satisfaction of working with your head to keep up with new equipment and processes or to become a specialist in a chosen field.

FIELDS OF WORK

Mechanical repair occupations provide employment for approximately 200,000 workers or 3½ per cent of the total labour force in Canada and will be found in almost every kind of industry and business across the nation.

About half of the total number of mechanics and repairmen work in wholesale and retail establishments which supply farm equipment, motor vehicles, hardware and similar items, or are in stores and other outlets which sell and service household appliances, watches, locks, bicycles, sporting equipment, business machines and other items; these establishments are located in almost every community across the country.

The next largest group—about one quarter of the total—are employed in manufacturing industries which tend to be located in main population centres. Although a high proportion of these workers are employed in large plants which produce primary metals, machinery products, railway equipment and motor vehicles, virtually all manufacturing plants have one or more repairmen on their payroll.

Relatively large numbers of those workers are in the transportation field and maintain railway equipment, marine vessels, aircraft and heavy vehicles in running order. Municipal, provincial and federal government agencies depend heavily on the skills of mechanics and repairmen as do gas and electrical companies, mining companies and construction firms.

In addition to employment in a fixed location, i.e., a retail store or a manufacturing plant, increasing numbers of mechanics and repairmen are employed in what is called "contract maintenance" and this usually involves considerable travelling. Probably the most familiar of these is the serviceman on the payroll of an oil company who periodically visits homes to ensure that the heating system functions correctly.

Communications companies, radio and television stations and power generating and distributing companies also employ substantial numbers of repairmen to service their equipment but, as a general rule, this work is undertaken by workers trained in electricity rather than in mechanics; details of these occupations are given in ELECTRICAL AND ELECTRONIC OCCUPATIONS in this series (*see* inside front cover).

NATURE OF WORK

Most mechanics and repairmen specialize in one type of product or service as indicated by their occupational titles, i.e., appliance serviceman, instrument mechanic, millwright, construction equipment mechanic or coin-vending machine mechanic.

As can be expected, the nature of their work varies considerably with the specialty but, basically, all mechanics and repairmen are concerned with finding the cause and correcting defects in malfunctioning equipment and, particularly, in preventing their reoccurrence. This calls for all-round skills in the use of handtools, versatility and, at times, the ability to improvise. When the trouble has been located, repairs are usually effected by installing new or reconditioned parts supplied by the manufacturer; however, depending on the specialty, the mechanics may have to use machine tools such as a lathe and additional skills to make a replacement part. In a number of occupations, a knowledge of basic electricity is required since an increasing number of products now incorporate electrical systems and components.

Although skills with the hands and with handtools are of great importance, they form only part of the requirements needed for success. Most repair jobs present new problems and analytical ability is necessary to find the cause of trouble and to put the mechanism back into working order.

Preventive maintenance is also another important function and is the main task of a number of mechanics. For example, aircraft mechanics or bus mechanics do not wait for trouble to develop but have a regular routine and test or examine components for any defects which could develop into serious failures.

Physical requirements vary greatly as do other personal qualities. The millwright has to climb ladders, lift heavy equipment and may work in cramped and confined positions. In contrast, the watch repairman need not be an athlete but does require exceptional finger dexterity and considerable patience. A courteous and pleasant manner is essential for those employed in retail outlets.

To be successful, repairmen need a natural bent towards mechanics, that is, they must have a genuine interest in finding out how mechanical things work or "why the wheels go round". Many mechanics have found or developed this interest during high-school shop courses; others have purchased an old car and discussed their mechanical problems with vocational instructors or the local garage operator.

Probably the most important personal quality—after mechanical curiosity—is a willingness to broaden one's knowledge, skills and experience. The almost endless flow of new processes and products entering the market require mechanics and repairmen to have a sound basic education and to be willing to study further to keep up-to-date with all the latest technical changes.

AUTOMOTIVE REPAIR OCCUPATIONS

During 1964, over six million vehicle licences were issued in Canada of which five million were for passenger cars. The servicing and repair of these vehicles provided employment for approximately 90,000 mechanics and related workers in establishments located in almost every section of the country.

More than half the total number of mechanics are employed by general and specialty garages and in the service departments of automobile, truck and farm equipment dealers and wholesalers.

Many large manufacturing, transportation and commercial companies operate repair shops to service their own fleet of cars, trucks and heavy duty equipment. Municipal, provincial and federal government departments, especially those concerned with urban transit systems and with highway maintenance, also operate repair depots for all types of publicly owned vehicles.

A small number of mechanics (about 9,000) are employed in gasoline service stations. To an increasing extent, service stations are now undertaking general or specialized repairs (usually on passenger cars or light trucks); although many do only minor adjustments or install accessories employment for qualified mechanics in this field is growing.

Internal combustion engines are also used extensively in many fields such as the construction, petroleum and logging industries, or in such items as marine pleasure craft or grass mowers.

One branch of the automotive trade—body-and-fender repair—is a combination of sheet-metal forming and welding and the general mechanic is not expected to be skilled in this specialty. The automotive machinist is now usually employed in separate machine shops or by wholesale dealers and is not included in this booklet; METAL WORKING OCCUPATIONS, in this series, describes machining and related work in detail (*see* inside front cover).

Motor Vehicle Mechanic

Nature of Work: The general *motor vehicle mechanic* requires all-round proficiency in the servicing and repair of the mechanical, electrical and related systems of a vehicle. These include the engine and accessories, wheels and chassis, transmission, steering and brake mechanisms, and the generation, ignition, starting, lighting and other electrical systems. While obviously skilled in all aspects of motor vehicle work, the general mechanic is often especially adept in the servicing of internal combustion engines, a skill which he also may apply to power boats, grass mowers and similar items.

In smaller garages, the general mechanic has a wide range of duties and requires the ability to diagnose and repair faults on many different makes and kinds of vehicle (passenger cars, light trucks, farm vehicles, etc.). Larger garages often maintain and repair one make of vehicle and the work is divided among several specialists.

In all repair work, the first and obvious step is to diagnose and locate the source of trouble. To achieve this, the mechanic discusses symptoms with the customer, makes visual inspections and listens for abnormal noises. To an increasing extent, however, electrical or electronic test equipment such as the following are employed to detect faults: voltmeters and test lamps to check electrical circuits; compression analyzers to test engine efficiency; gas analyzers which indicate the efficiency of the carburetion system; and multiple analyzers which test several systems simultaneously. Wheel balancing and braking efficiency are also determined with measuring devices.

Probably the most important asset in vehicle repair work is the ability to detect and locate faults and, for this reason, is usually undertaken by a specialist. When the fault has been located, the customer may require an estimate of costs which either the mechanic, a write-up man or the service manager will provide.

Next, corrective action including carburetor adjustment, resetting brakes or soldering broken electrical connections may be done on the vehicle. It is more likely, however, that defective units will be removed from the vehicle for servicing in the shop. The usual practice in most garages is to install new or factory-reconditioned units

rather than to make extensive repairs, although this depends on availability of spares in a particular area. In some instances, defective units which have been removed are returned to the manufacturer's or wholesale dealer's repair shops for overhaul.

Removal of units from a vehicle, dismantling and their reassembly and installation is the next step. Relatively simple jobs may be given to the new apprentice and include: removal, cleaning and testing spark plugs; grinding and reseating valves; chassis lubrication; or changing tires. More highly skilled work will involve stripping down an engine, opening a transmission system, reassembling a gearbox or installing a factory-reconditioned engine.

Handtools most frequently used are wrenches, socket sets, pliers and hammers although feeler gauges, rules, protractors and calipers together with the manufacturer's service manuals and drawings are in constant use. In addition, such hand operations as filing, hacksawing, scraping, tapping and threading are undertaken. Improvements in repair equipment in most shops have kept pace with the rapid developments in motor vehicle design and, in addition to hydraulically operated jacks and hoists, there is a wide variety of power tools—power saws and grinders, valve extractors and air-operated or electric wrenches—to assist the mechanic.

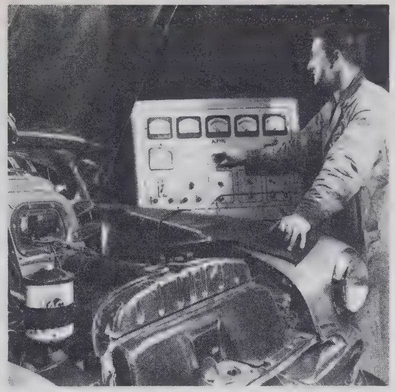
The general mechanic must also have a working knowledge of electrical systems. In smaller garages, he traces faults such as short circuits using voltmeters and test lamps, resolders defective connections, changes components and makes adjustments to the voltage regulator, distributor and other electrical units. Other mechanics may specialize on electrical work such as the servicing and overhaul of the ignition, starting, lighting and other systems.

Preparation and Training: Entry into this occupation is through an apprenticeship (page 109). During this period, the apprentice works in a repair shop and is taught the practical side of the trade by skilled mechanics. Full-time attendance, usually each year of apprenticeship in provincial institutes of trade, is required. In the institutes, about half the time is spent on classroom study in such subjects as: electricity; mathematics (including decimals, fractions, square roots, areas, volumes and percentages); science (pertaining

Photo: N.F.B. 74571

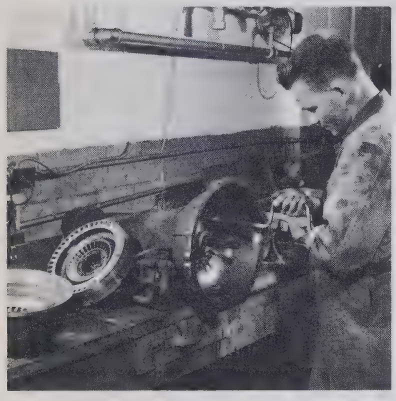
The foreman outlines repair procedures to the mechanics

Photo: N.F.B. 74559



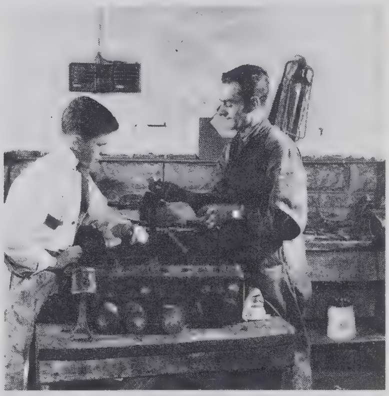
Electronic analyzers are an aid in trouble-shooting

Photo: N.F.B. 74564



Assembly of this hydromatic drive is highly skilled work

Photo: N.F.B. 74565



The apprentice is trained by a skilled tradesman

Photo: FORD MOTOR CO.

Wheel balancing requires special test equipment

Photo: N.F.B. 74557

The radiator repairman must understand welding techniques

to hydraulics, chemistry of petroleum products and combustion); theory and operating principles of internal combustion engines and related systems; business practices and regulations; the rest of the time is occupied by supervised training in techniques which are difficult to learn on the job. In some provinces, full-time courses are not available and the apprentice attends evening classes (page 110).

Apprentices are required to purchase a kit of personal tools which will amount to several hundred dollars; this investment can be spread over several years and does not present a hardship.

Personal Qualities: The motor vehicle mechanic leads an active life with much bending, stooping and lifting. Good eyesight is essential as is the ability to hear and interpret knocks, rattles and squeaks which are usually the first signs of defects.

Working Conditions: Most garages are comparatively clean (although all mechanics come into contact with dirt, oil and grease) and are well equipped with labour-saving devices and power-operated tools. In smaller garages, the mechanic may be required to answer service calls at all hours and to go out in inclement weather: this has been the exception rather than the rule and most repair jobs are fitted into a normal time schedule leaving the evenings reasonably free. There is now some increase in evening or night work, particularly in the cities.

Advancement: For the above-average mechanic there are several opportunities for promotion. Some go on to specialize in motor tuning or transmission system overhaul for which a higher rate of pay is given; others with organizing ability advance to chief mechanic or foreman. Additional training courses, both full-time and part-time, are provided in trade schools and in institutes of technology for mechanics who may wish to specialize and also provide a background for advancement to service salesman, service manager, field service engineer and similar positions. There are also opportunities to become self-employed by opening a garage or a gasoline service station. These businesses are highly competitive and success depends not only on mechanical ability but also on a sound knowledge of business practices. For garage operators a courteous and pleasant personality is essential to deal successfully with the public.

Future Outlook: The principal trend in motor vehicle work is towards specialization. As mechanics develop their ability there is a tendency, especially in larger garages, to concentrate on certain branches of automotive repair. A number of developments have taken place, particularly the equipping of light vehicles, taxi-cabs and some passenger cars with diesel engines. It is expected that, because of greater efficiency in the use of fuels, the number of diesel-powered light vehicles will increase. However the basic parts of diesel engines are similar to those of gasoline engines and, in some garages, they are serviced by general mechanics. Courses in diesel engine work are offered in a number of trade schools through which ambitious mechanics can upgrade their skills.

Although it is too early to assess the full effects of other major developments such as the introduction of turbine-powered units, these are not expected to alter the basic duties of the general mechanic. When changes have been made in the past, training has been provided by manufacturers and courses added to the curricula of vocational schools through which the general mechanic has been able to acquire additional skills. This is expected to continue and, in the next decade, occupations such as "automotive turbine-engine mechanic" or "technician" are likely to emerge. Diesel and turbine units have fewer working parts than engines currently in use resulting in longer engine life and this could lead to some slight reduction in the numbers of mechanics; both these units must be serviced to extremely high standards of accuracy and the ability to use precision measuring equipment and to work to fine limits will increase in importance.

When comparing prospects in various fields it should be noted that automotive servicing offers reasonably regular employment to the well-trained mechanic. Maintenance begins with the purchase of a vehicle and continues at an increasing rate as the vehicle becomes older. When general economic conditions are slow, there is a tendency to keep vehicles longer and this leads to sustained employment. The number of vehicles on the road continues to increase, which points to good employment opportunities for some time to come.

Specialty Mechanics

As previously mentioned, specialty mechanics are employed in the larger repair garages, in maintenance shops operated by transport companies and in repair shops which provide one type of service only. A number of these mechanics are trained initially as general mechanics and, through natural ability supplemented with manufacturers' training courses, part-time study, or upgrading courses in trade schools or institutes of technology, have developed a high degree of skill in one branch of automotive work. However, some workers such as radiator repairmen and wheel alignment mechanics often receive all their training in one specialty only. Typical of the many specialist occupations are the following:

Automobile repairman (write-up repairman)—diagnoses and locates faults or determines the extent of damage in vehicles involved in collisions. He prepares estimates of costs for the customer and writes up work orders for the mechanics who will later make the repairs. In addition, he may supervise jobs while in progress, inspect the vehicle on completion and make final tuning adjustments. Fault diagnosis is one of the most highly paid jobs in the garage and is usually filled by promoting a good general mechanic.

Transmission and differential repairman—as the name implies, is required to remove, dismantle, overhaul and reinstall that part of the power train known as the transmission and differential system. The work includes: stripping down gear assemblies, lever systems, shafts and bearings which are examined for excessive wear, end play, insufficient tooth contact and similar defects; replacing parts which are outside the limits of accuracy detailed in manufacturers' servicing manuals; checking and adjusting rods, cables and other shifting linkage and vacuum or electrically powered assists; and the examination of electrical components such as relays and solenoids. Maintenance of complex automatic transmission systems may be the work of a further highly specialized mechanic—the *automatic transmission repairman.*

Wheel alignment mechanic (also called a front-end repairman)—tests and corrects faulty alignment of frames, wheels, suspension assemblies and the steering mechanisms of cars, buses, trucks and

other vehicles. He uses instruments and testing devices such as the "Visualiner" to check for twisted frames, bent axles, misalignment and incorrect camber (tilt) or toe-in of wheels, and other defects. To make the necessary repairs, the mechanic either installs replacement parts or, as is more likely, uses hydraulic jacks, chassis aligners and similar power-operated devices together with hammers, prying bars and other handtools. This and the following occupation are usually learned on the job without benefit of all-round apprenticeship training.

Radiator repairman—cleans, tests and repairs the cooling system in cars, trucks, buses and tractors. The work involves testing the radiator, motor block, hoses and pump for leaks under pressure; repairing and installing hoses, thermostats and pumps; soldering radiator cores; and cleaning the complete cooling system.

Body-and-Fender Repairmen

Nature of Work: The *body-and-fender repairman* (also called an autobody man) is employed on a combination of welding, and sheet-metal beating on cars, trucks, buses and similar vehicles which are damaged through impact, corrosion or other causes. He straightens bodies, fenders and frames, beats out dents and replaces sections and parts which are damaged beyond repair. Also included in the duties are upholstering, painting and glass installation.

Specialty body shops whose main business is that of repairing collision-damaged vehicles, and the servicing departments of motor vehicle dealers employ the larger proportion of body-and-fender repairmen; their workshops are located in most communities across the country. Other repairmen are in garages, chiefly in major population centres, where they work on company-owned fleets of trucks, cars or buses. A few gasoline service stations also provide minor body repair services.

The first task of the repairman on a damaged vehicle, or of the foreman in larger shops, is to prepare a cost estimate for the customer—usually an insurance company. To do this, he determines the extent of visible damage, checks the alignment of such features as the chassis, steering gear and frames which may be less obvious, and decides which parts can be repaired and those which must be replaced. It should be noted that chassis straightening and steering gear repair may be the work of other specialists and are not normally included in the duties of the body-and-fender man.

Small parts such as chrome trim, lamps, louvres and grill sections and some parts of the upholstery are removed, either because they are damaged or would interfere with repair operations. The repairman then removes badly damaged or corroded sections of sheet metal either by unbolting or, as is more likely, by cutting with a pneumatic gun or a welding torch.

Next, damaged parts such as fenders are forced back towards their approximate original shape with hydraulic jacks, prying bars and a power-operated tool called a "dozer", together with large pneumatic

or hand hammers. The metal is then "bumped" with smaller hammers to a more accurate shape and, during this operation, it is often necessary to "shrink" the metal by repeated heating with an acetylene torch and cooling. To remove dents and ripples, further bumping is undertaken while the metal is backed with steel or wooden "dolly" blocks. Low spots and depressions are tapped with a picking hammer and are filled with solder (or materials such as plastic compounds) which the repairman files and grinds with power-sanding discs until they are smooth.

Throughout the foregoing operations, constant checks are made for correct alignment, body contour and door curvature using rules, calipers and dividers although the experienced repairman relies to a large extent on his ability to judge these features by eye.

Various cracks may have to be welded and replacement sections of sheet metal, which the repairman has cut to size and partly formed on the bench, are secured in position by welding or by rivetting.

New parts including chrome trim, grill sections and the locks, striking plates and door handles are then installed and the repairman may have to drill and thread accommodating holes and check the installation for correct functioning. In addition, cracked or broken glass is replaced in door and window frames and any necessary repairs made to the seats and upholstery.

Finally, the repaired areas and replacement sections are coated with priming paints which are smoothed with electrical sanders until they blend in with the edges of the existing paint. To complete the job, the repairman sprays the vehicle with coats of finishing paint or this work may be handed over to a spray painter.

Preparation and Training: Apprenticeship training under the direction of skilled workers is the recommended route to body-and-fender work and is a requirement in several provinces (page 110). During the training period, the learner is required to purchase certain handtools such as wrenches, pliers, hammers, metal cutters, rules and calipers; a basic kit costs about $100. However, many body-and-fender men are paid bonuses on the amount of work they do and often purchase additional tools amounting to several hundred dollars to increase their output.

Working Conditions: Repair shops are noisy from the hammering which takes place, the work is dirty and there is a fair amount of paint fumes, grit and sanding dust; in average and large size shops, dust extractors and paint spray booths reduce these conditions to a minimum.

Body-and-fender repair is heavy manual work where all basic operations are performed by hand. Physical activities include long periods of standing, kneeling, bending and crouching and both hands are used to hammer and to hold dolly blocks often for long periods.

The usual work period is an eight-hour day, forty-hour week. Longer hours may be worked, depending on the number of repair jobs in hand, particularly during the early summer months when there is an increase in pleasure driving and in the Fall with the onset of icy road conditions.

Wages vary according to the individual employer and the ability of the repairman. Some receive a fixed hourly rate; others receive payment for the amount of work done. This payment is based on a fixed amount of time to complete a particular repair so that if the repairman completes the job in a shorter time he receives the full payment and is free to go on to the next vehicle.

Advancement: Most shops employ a foreman while the larger shops offer opportunities to advance to estimator. The position of assessor or adjuster with an insurance company is another possibility. Some body-and-fender repairmen have gone on to establish their own businesses but it is emphasized that a sound knowledge of business practices—accounting, estimating and customer relations—is essential.

Future Outlook: Long-term prospects for employment are good. Each job presents a different set of problems and the repairman relies on his own judgment and practical experience to decide the most suitable way to do a particular repair. As a result, this is a craft which is little affected by machinery or mass-production and, incidentally, should appeal to those who like variety and obtain personal satisfaction from seeing their finished work. The number of vehicles continues to increase with consequent increase in the number of mis-

haps; a large number of vehicles now carry insurance, which is compulsory in some provinces, and as a result there is more likelihood of vehicles being promptly repaired rather than be left in a damaged condition or scrapped.

HEAVY-DUTY (DIESEL) REPAIR OCCUPATIONS

Diesel engines are widely used to power the heavy-duty equipment of industry and their application continues to grow. In the field of transportation, probably the most spectacular application has been the conversion of locomotives from steam to diesel power; diesel engines are fitted in buses, heavy trucks and farm tractors; in marine and naval vessels and in pleasure craft; and their use is being extended from pick-up trucks and taxis to passenger cars. Because of this widespread application, employment opportunities in diesel repair work will be found in all parts of the country.

There are many other applications: in the construction field, diesel engines are widely used in heavy, earth-moving equipment and for drilling, hoisting and material handling; they are used in electrical power-generating stations and in small factories, oil drilling rigs, pumping stations, mines, logging camps and other establishments which are isolated from the usual power sources.

It is not possible to give numbers of workers in diesel repair for, in addition to clearly defined occupations such as diesel mechanic, heavy-duty mechanic and construction-equipment mechanic, diesel engines are maintained by railroad mechanics, heavy vehicle and bus mechanics, marine engineers, stationary engineers and by motor vehicle mechanics who may have been trained initially on gasoline-powered vehicles.

Diesel Mechanics

Nature of Work: The basic duties of all diesel mechanics are similar in that they are concerned in one or several of the following: trouble-shooting, disassembly, repairing or replacing defective components, assembly and installation, and calibration and tuning. However, there is considerable specialization: some mechanics undertake routine maintenance and clean, adjust and tune or remove units at

specified intervals for overhaul on the bench; others work exclusively on engines where the work is similar to that done on gasoline engines; others may specialize in one branch such as fuel injection system overhaul which is the most highly precisioned part of the diesel engine.

In addition to engine servicing, some mechanics maintain auxiliary units—hydraulic equipment, shovel attachments, drum hoists, etc.—as will be explained in later paragraphs.

Heavy Vehicle (Diesel) Mechanics

Vehicles such as buses and heavy trucks (usually over 3 tons) are often owned by large companies or government departments who operate their own garages or repair shops and in them train their own personnel although a few of these vehicles, such as the school bus on rural routes, together with lighter delivery vehicles may be serviced in general garages.

The *heavy vehicle mechanic* who may be called a bus mechanic or a diesel mechanic is basically a motor vehicle mechanic whose duties are similar to those of mechanics in general garages except that parts, tools and so on are on a much larger scale and frequently a helper is employed. There is, however, one major difference: although heavy vehicle mechanics handle breakdowns, their main task is to prevent these from occurring through what are called "preventive maintenance routines". These routines affect heavy vehicle mechanics in that they have less opportunity for personal planning and are more concerned with testing, dismantling and replacement of components as detailed in maintenance schedules rather than with fault diagnosis. However, the routines are so planned that the mechanic has a steady flow of vehicles thus avoiding to a large extent "peak" periods of work and periods of underemployment.

All buses and most transport vehicles are taken off the road when they have covered a certain mileage. Frequently the brakes, steering gear, tires and other parts involving safety are examined or tested for defects. At longer intervals, units are removed from the vehicle for reconditioning in repair shops where they are stripped down and examined for defects which could develop into breakdowns.

Unlike maintenance work in light vehicle garages where units which have been removed are returned to the wholesaler, considerable reconditioning work is done in the transport company's garage, or in a repair and machine shop attached to the garage, because of cost, size and other factors. As a result, mechanics in heavy vehicle garages are often engaged in one branch of maintenance such as engine overhaul, wheel alignment or transmission system servicing or machining, welding, body-and-fender repair or related work.

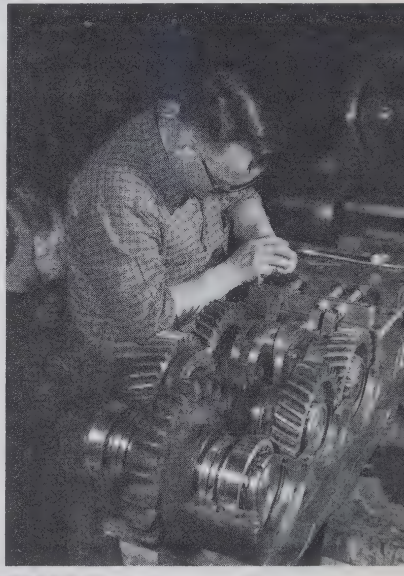
About 70 per cent of the components in diesel engines used to power buses and other heavy vehicles are similar to those of gasoline engines, the main difference being that diesel engines are not fitted with spark plugs or carburetors. Instead, the work offers considerable variety since the heavy vehicle mechanic is concerned with injection systems comprising pumps which force fuel under high pressure into each cylinder, or injectors and nozzles which release the oil as a fine spray, and with fuel-transfer systems and governors, all of which must be serviced and calibrated to extremely high standards of accuracy. In addition, these vehicles use air pressure to control the brakes which involves compressors and air reservoirs. Other auxiliary equipment including air suspension units, gasoline heaters and gasoline starting systems all add to the diversity and often result in the mechanic specializing in a single branch.

Preparation and Training: Apprenticeship is the recognized route to heavy vehicle repair occupations (page 110) during which time the apprentice is employed in a bus or heavy vehicle repair shop and attends trade school each year of apprenticeship. As in most vehicle repair occupations, the mechanic must purchase a kit of handtools. In the first year or two this will amount to about $100; often experienced mechanics will have $500 invested in tools.

Personal Qualities: As can be expected, the main handtools—wrenches, screwdrivers and pliers—are of the heavy type and are supplemented with power-operated equipment. Unlike those of passenger cars, many of the units in heavy vehicles are designed for ease of removal and, although these units are heavy, repair shops are well equipped with hydraulic jacks and other lifting tackle and power-operated tools; however, a better than average physique is necessary. In addition, the mechanic at times works in bent, stooped and twisted positions which will call for sustained physical effort.

Photo: N.F.B. 63-4298

Photo: N.F.B.

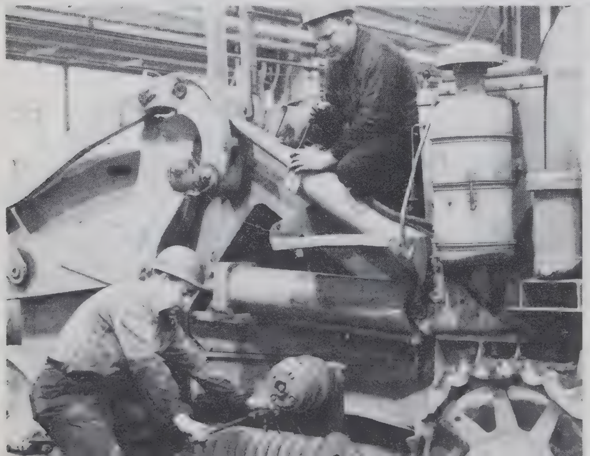


Above: examining a bombardier for defects

Centre: reassembly of a hydraulic mechanism used in coal-cutting operations

Below: diesel maintenance demands versatility

Photo: ALGOMA STEEL



Working Conditions: The larger fleet garages and bus repair depots are well planned and fully equipped; smaller garages may be somewhat congested. In all garages, fumes and odours will be encountered and the work is oily and greasy. Occasionally, mechanics are called out to a breakdown on the road and meet adverse weather conditions. Shift work, including evenings and nights can be expected, particularly for those employed on buses and other public utility vehicles.

Advancement: Opportunities include positions as chief mechanic, foreman and shop supervisor. It is possible for mechanics in fleet garages to move into the planning office as maintenance scheduler or the operations office as a dispatcher; extensive experience, leadership and a strong desire to acquire additional knowledge are important factors in advancement.

Future Outlook: Bus routes are being extended with the growth of population and increases in the number of people who commute from the suburbs. With the economic advantages of diesel power, the number of transport vehicles fitted with these units continues to grow, thus creating additional employment opportunities. The heavy vehicle mechanic's skills are also in demand for the maintenance of trucks in the construction field where considerable expansion is indicated, and in agriculture where there is a continued trend towards more mechanization. All of which points to a good employment outlook for some time to come.

Construction-Equipment Mechanics

Construction-equipment mechanics must be extremely versatile for, in addition to servicing and maintenance duties, they are required to have a full understanding of the principles of both motive power (gasoline and diesel) and the auxiliary units of mobile and stationary earth-moving and material handling machines used in the construction industry. These include trucks, bulldozers, draglines, loaders, air compressors, drills, portable power plants, concrete mixers and similar machinery.

Nature of Work: On the construction site, the mechanic's duties are usually limited to routine maintenance such as engine tuning, adjustment of fuel-injection system components (or the carburetion system of gasoline engines), wheel or track changing, steering and brake adjustments and similar running repairs. However on large sites, and particularly those which are isolated, major repair depots are often set up. An increasing amount of construction equipment is now being leased from rental companies and, where this is done, the equipment is returned at periodic intervals for overhaul in the owner's repair depots and machine shops.

In repair shops, the work of the mechanic will include: bench fitting such as dismantling and assembling major units, pinfitting, valve servicing and overhaul; tuning the engine and related carburetors, fuel pumps and governors; adjusting or servicing distributors, generators, alternators, and starters; and servicing the steering systems, brakes and power trains.

The foregoing duties are very similar to those of the heavy vehicle mechanic. However, the construction-equipment mechanic, in addition, is required to service, maintain and overhaul: power control units and winches and the master and steering heavy-duty clutches; transmission systems shifts, torque converters, sprockets and grousers; drive lines and differentials; and the blades, shovels and other material-handling units of construction machinery.

Preparation and Training: The craft of construction-equipment mechanic is learned through different patterns in different provinces but, in general, preparation and training are similar to that of the heavy vehicle mechanic. The larger construction or equipment rental companies often provide their own training programs which, in some provinces, are registered under an apprenticeship training scheme.

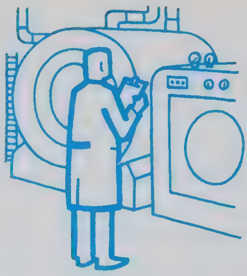
Personal Qualities: Maintenance of construction equipment requires a robust constitution since the work is strenuous and on some construction sites power tools may not be readily available. Adverse weather conditions will be encountered on the site and, during the summer months which is the period of greatest construction activity, considerable overtime is worked. Major repair depots

offer a somewhat different set of working conditions; they are usually situated near large population areas, are well lighted, hours of work are regular and although the work is still strenuous the depots are fully equipped with power-operated tools and hoisting devices.

This type of work should appeal to those who, in addition to being versatile, are willing to travel. Living conditions on construction camps and working conditions on the site may be rougher than those experienced at home but offer an inducement in the form of overtime and bonus pay.

Advancement: There is a good line of promotion to specialist occupations for which a higher rate of pay is given and to site foreman, shop supervisor or field service engineer.

Future Outlook: Based on projected expenditures in the construction industry over the next decade, employment opportunities for mechanics will be excellent and there are indications that, at times, demand will exceed the supply.

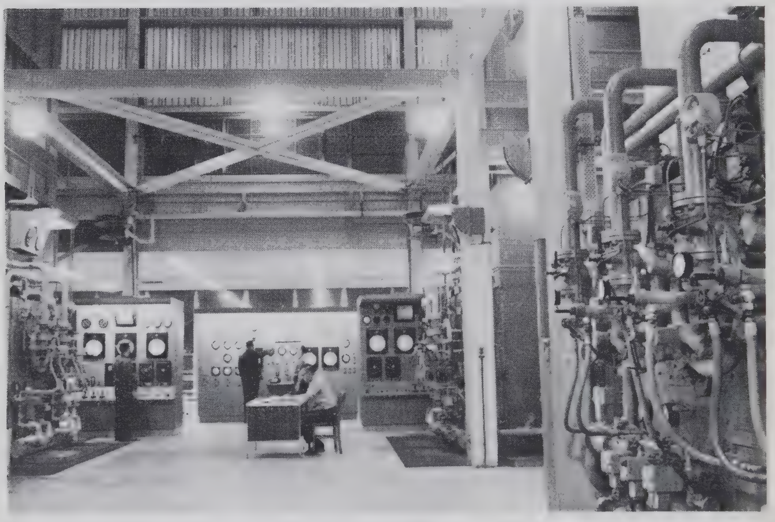


Stationary Engineers

The main task of *stationary engineers* is to ensure the safe and efficient operation of the coal-fired, oil, gas or electrical plant and the turbines, pumps, condensers, generators and other auxiliaries which provide heating, air-conditioning or refrigeration in buildings or are used as a source of mechanical or electrical power. In various provinces, alternative titles are used: *operating engineers* (Ontario and Manitoba), *steam engineers* (Saskatchewan and Alberta), *stationary enginemen* (Quebec), *engine operators* (Nova Scotia) or *power engineers* (currently gaining use in all provinces).

They are employed in pulp and paper mills, oil refineries, food processing plants, electrical generating stations, public buildings and institutions (hospitals, schools, etc.) and manufacturing plants which will be found in all parts of the country. Others work in the larger population centres, chiefly in government and other public buildings, industrial plants, hotels and in apartment blocks. According to the 1961 edition of the Census of Canada there are approximately

Photo: DEPARTMENT OF TRANSPORT



Operation of a modern heating plant offers excellent working conditions

30,000 stationary engineers but this figure does not include those employed in certain fields such as public utility companies.

Preventive servicing routines and mechanical repair functions are included in the duties of all stationary engineers but will vary according to the type of plant, the nature of the employer's business and the purpose for which the plant is being used.

Stationary engineers observe gauges, record instrument readings and check such factors as fuel consumption, feedwater treatment, water supplies and steam pressures. From these data, they ensure efficient operation of the plant by adjusting levers, switches, valves and various control devices. In addition, the engineers are required to detect and locate faults by analyzing the data and by listening to the machinery, and to apply periodic maintenance routines. Servicing includes the supervision of fueling operations (coal, oil, natural gas or nuclear power), oiling and greasing of moving parts and removal of scale with chipping hammers from boiler walls. They reseat valves, replace gaskets and make mechanical changes such as installing new valves, pipelines, replacement shafts and drive mechanisms. Dismantling and overhaul of major units would probably be done under the direction of a chief stationary engineer by electricians, diesel mechanics and the craftsmen described in METAL WORKING OCCUPATIONS (*see* inside front cover) such as machinists, licenced boilermakers and licenced welders.

Considerable overlap will be found between the duties of stationary engineers and the millwright (page 44). Stationary engineers may have additional duties and be responsible for the maintenance or repair of drive shafts, pulleys and other mechanisms which transfer mechanical energy from the stationary plant to machinery used in the manufacturing or industrial processes.

Where the stationary engine is used for heating, cooking, sterilizing or laundry services, such as in hospitals, the duties of the engineer could include the control of water supplies, refrigeration, plumbing, sewage disposal and fire alarm systems. In these establishments, he may repair or maintain steam traps, water or steam pipelines, radiators and associated equipment. This work requires a knowledge of the codes and practices related to plumbing, steamfitting, air-conditioning and electrical installations.

PROVINCE	FOURTH CLASS	THIRD CLASS	SECOND CLASS	FIRST CLASS	REMARKS
NEW BRUNSWICK minimum age......... experience............	...18 years ...6 months... allowed to take charge of high-pressure plant up to 50 h.p.	...one year... (as holder Fourth Class Licence or two years experience under supervisor); allows holder to take charge of high-pressure plants up to 100 h.p.); allowed to take charge of high-pressure plant up to 100 h.p.	...two years... (as holder Third Class Licence; total of four years experience required including two years on high-pressure plants over 200 h.p.); high-pressure plants up to 600 h.p.	...two years (as holder Second Class Licence; total of six years experience including two years on plants over 600 h.p.); take charge all plants.	Stationary Boilerman's licence required for work on low-pressure systems (three months experience).
QUEBEC minimum age......... experience............	...20 years ...18 months... (as fireman) allowed to take charge of plant up to 200 h.p.	...18 months... (as holder of Fourth Class Certificate); plants up to 400 h.p. (heating) or, 600 h.p. electric boilers.	...two years... (as holder of Third Class Certificate); plants up to 600 h.p.	...two years (as holder of Second Class Certificate); unlimited	Note: Certificates are issued in following categories: Grade A—heating plants; Grade AB—both heating and power plants; also for specific fields including sawmills; butter, cheese or dairy; or refrigeration.
ONTARIO minimum age......... experience............	...19 years... ...one year... (high-pressure plants over 25 h.p. *or*, low-pressure plants over 75 h.p.)	...21 years... ...two years... (high-pressure plants over 75 h.p. *or*, low-pressure plants over 200 h.p.)	...23 years... ...two years... (high-pressure plants over 200 h.p.)	...25 years ...three years... (high-pressure plants over 600 h.p.)	Licences also required to operate refrigeration plants. Qualifying service may be on land or sea.

PROVINCE	FOURTH CLASS	THIRD CLASS	SECOND CLASS	FIRST CLASS	REMARKS
MANITOBA minimum age......... experience............	...18 years ...one year... (high-pressure plants over 100 h.p.); or two years (low-pressure plants over 200 h.p.)	...two years... (high-pressure plants over 100 h.p.)	...18 months to two years (or membership Prof. Eng. Association plus one year).	...one to three years.	Note: Practical experience requirements reduced for graduates (Institutes of Technology) or those eligible for membership, Prof. Eng. Associations. Licences also issued in several other categories—Fifth Class, Fireman, Refrigeration, etc.
SASKATCHEWAN minimum age......... experience............	...19 years... ...one year... (high-pressure plants over 25 h.p.)	...20 years... ...one year... (as holder of Fourth Class Certificate; plants over 75 h.p.)	...22 years... ...one and a half years on plants over 175 h.p.	...25 years ...three years on plants over 300 h.p.	Licences also required—Provincial Certificate, Fireman's Certificate, Refrigeration Engineer's Certificate.
ALBERTA experience............	...not stipulated... experienced on boilers of 100 h.p.	...four years... (plant of 300 h.p.)	...four years... (plant of 750 h.p.)	...four years (plant of 1000 h.p.)	For all licences (except Fourth Class), five years mechanical experience required.
BRITISH COLUMBIA minimum age......... experience............	...18 years... ...one year... as engineer (or fireman)—high-pressure plants over 10 h.p. *or* low-pressure plant over 100 h.p.	...20 years... ...two years... as engineer *or*, one year as engineer plus one year as fireman *or*, four years fireman *or*, two years as mechanic plus one year as engineer on plants over 50 h.p.	...22 years... ...four years... as engineer *or*, three years in Machine Shop plus two years as engineer on plants over 250 h.p.	...26 years ...four years as Second Class Engineer.	Qualifying service may be on land or sea.

LICENCING REQUIREMENTS FOR STATIONARY ENGINEERS IN SELECTED PROVINCES

Preparation and Training: Provincial regulations require stationary engineers to be licenced where the plant exceed certain horsepower or pressure ratings. The regulations vary in each province but all are based on practical operating experience and written examinations. The licences range from Fourth Class to First Class (the highest category).

The usual method of entry has been to obtain employment as a helper, stoker, fireman or oiler. During this period, the new entrant learns how the stationary equipment is operated, maintained and repaired and the use of a variety of hand and machine tools such as chisels, wrenches, hammers, drill presses and lathes. This practical training has to be supplemented with part-time study in mathematics (areas, volumes, heat calculations), the related subjects of practical chemistry, elementary physics, applied electricity and the theory of heating, air-conditioning and refrigeration. This will provide sufficient knowledge and experience to write the examinations required for a fourth-class licence. It is then necessary to obtain additional experience on more powerful engines before an applicant is allowed to write the examinations for third class and higher licences, as will be seen in the extracts from several provincial regulations given on page 32. Full details of the regulations can be obtained from agencies of the provincial Departments of Labour (except in Alberta where licencing is administered by the Department of Works).

Increasing use of automatic fuel-handling equipment and control devices has reduced the number of entry occupations and is necessitating a higher educational standard. This, in turn, has affected traditional methods of entry and training and it is now the usual practice to take pre-employment courses before seeking a job. Page 36 lists a number of institutions offering pre-employment training and also part-time or correspondence courses for those who wish to upgrade their knowledge before applying for higher licences.

Personal Qualities: Stationary engineering is indoor work and although an average physique is necessary it is not considered very strenuous since most up-to-date plants are equipped with built-in lifting and hoisting tackle. Most plants operate on a 24-hour basis and this necessitates shifts—day, evening, night and week-ends—which are rotated. Essential personal qualities are alertness, stability and a keen sense of responsibility since carelessly handled plants are a hazard to public safety. For this reason, provincial regulations specify minimum age requirements for each class of licence, require character references and impose cancellation of licences for misdemeanours.

Advancement: The usual line of promotion, as vacancies occur and as the necessary licences are obtained, is from fourth-class engineer to positions such as assistant or chief shift engineer. Further advancement is possible with succeeding licences to chief operating engineer; this is a salaried position where rates range from $6,000 to over $8,000 per annum (based on 1964 Civil Service salary schedules).

Future Outlook: The employment outlook during the 1960's is favourable with a moderate rise indicated in the number of new employment opportunities in addition to normal openings which will result from retirements or transfers to other fields. Activity in the construction industry over the next decade indicates that there will be a considerable increase in the number of new buildings employing heating, air-conditioning and refrigeration plants; however, modern buildings will be equipped with automatic fuel-handling and other control devices which will have a limiting effect on the growth of new employment opportunities.

FULL-TIME AND PART-TIME COURSES

MANITOBA INSTITUTE OF TECHNOLOGY,
Winnipeg, Man.
a 40-week course
high school required

* * *

SASKATCHEWAN TECHNICAL INSTITUTE,
Saskatoon, Sask.
a 5-month course
Grade 10 required

* * *

SOUTHERN ALBERTA INSTITUTE OF TECHNOLOGY, Calgary, Alta.
(a) a 90-hour, 4th class licence course
No entry requirements.
(b) a 2-year Power Engineering Technology course.
Alberta High School Diploma with "B" standing in Maths and Physics required

* * *

VANCOUVER VOCATIONAL INSTITUTE, Vancouver, B.C.
(a) Boiler operator's course; hourly basis of varying length, both full-time and part-time available
(b) 2-year Technical Course

* * *

COLLEGE OF TRADES AND TECHNOLOGY, St. John's, Nfld.
a short diploma course

* * *

CENTRAL TECHNICAL SCHOOL,
275 Lippincott St., Toronto, Ont.
short courses for all classes of licence

* * *

INSTITUT DE TECHNOLOGIE DE VAUDREUIL,
Côte des Jeunes, Vaudreuil, Que.
3-year technical course

* * *

80-hour evening courses for each class of licence are offered at the following schools—
INSTITUT DE TECHNOLOGIE DE MONTREAL, Montreal, Que.
INSTITUT DE TECHNOLOGIE DE QUEBEC, Quebec, Que.
ECOLE DE METIERS,
Cap-de-la-Madeleine, Que.
ECOLE DE METIERS,
Port-Alfred, Que.
ECOLE DE METIERS,
Salaberry-de-Valleyfield, Que.

CORRESPONDENCE COURSES ONLY

NEW BRUNSWICK
Department of Vocational Education,
Fredericton, N.B.
Unit 1....................17 lessons
Unit 2....................16 lessons
Unit 3....................13 lessons

* * *

NOVA SCOTIA
Correspondence Study Branch,
Box 1650, Halifax, N.S.
4th class..........20 lessons
Grade 7 acceptable
Grade 9 preferred

* * *

ALBERTA
Correspondence Instruction Branch,
Southern Alberta Institute of Technology, Calgary, Alta.
4th class..................18 lessons
average education
3rd class..................30 lessons
Grade 9 required
2nd class..................27 lessons
Grade 11 required
1st class..................48 lessons
Grade 11 required

* * *

QUEBEC
Service des cours par correspondance,
9175 rue St-Hubert, Montréal 24, Qué.
machines fixes—4e classe—
première partie...........10 leçons
seconde partie............10 leçons
machines fixes—3e classe—
première partie...........20 leçons
seconde partie............20 leçons

* * *

Note........
This listing is complete at the time of going to press. Many trade and technical schools are at present extending their facilities and further information can be obtained by applying to the school in a particular area.

TRAINING COURSES AVAILABLE IN POWER PLANT ENGINEERING

Marine Engineers

Marine engineers are responsible for the safe, efficient and economical operation and maintenance of the engine-room plant and machinery used in ships for the generation and transmission of power, for the auxiliary equipment used in lighting, heating, refrigeration and ventilation, the pump systems, steering gear, and machinery such as hoists and winches. Although, traditionally, marine engineers are associated with coal-burning steam boilers, increasing use is being made of steam turbines and diesel-fuelled engines, either as the main source of power or for the auxiliary equipment and the marine engineer should be able to work on both types of engine; of the approximately 1,300 Canadian registered ships exceeding 100 tons gross, about 900 are powered with diesel oil or other internal combustion engines.

The main fields of employment are on the coastal and inland waters of the Great Lakes/St. Lawrence Seaway where there are over 200 ships of Canadian registry exceeding 1,000 tons as well as many smaller vessels. Other fields include the Pacific and Atlantic coastal regions on freighters, tankers, general cargo carriers, passenger ships and ferry boats. Marine engineers are also employed with fishing fleets (mainly Newfoundland, Nova Scotia and British Columbia) and on tugboats, barges, floating cranes and similar harbour craft. Others are employed in shipbuilding or repair yards on supervisory duties or on readying vessels for service.

A relatively large and expanding field is the Canadian Coast Guard Service of the federal Department of Transport which operates a fleet of over 200 vessels for ice-breaking, northern supply, search and rescue. The Department also employs a number of specially qualified marine engineers in Ottawa and in regional offices to implement safety and other regulations.

Nature of Work: On board ship, the duties of marine engineers and related staff will include the following: regulating the amount of water to the boilers, supervising fuelling operations (coal, diesel oil or, in the future, keeping watch on instruments which monitor nuclear fuel supplies); lubrication of moving parts; operation of controls which start, reverse, stop and regulate the speed of the vessel; and keeping watch on dials and gauges which record pressures, temperatures and other indications of the engine's performance.

In addition to operating duties, marine engineers are actively engaged in maintenance or mechanical repair functions. They keep major breakdowns to a minimum by organizing periodic routine examinations of the machinery and mechanical equipment. As far as possible, parts showing signs of wear and similar defects are replaced with spares and the defective part repaired in the ship's workshop. Facilities in the workshop vary with the size and type of ship: smaller ships are equipped with handtools and perhaps a drill press and a lathe; the largest ships have a well equipped machine shop.

Major overhaul and certain periodic maintenance routines can only be done when the engines are stopped and on vessels plying inland waters it is the normal practice to undertake this work in the home port. As a result, marine engineers may be extremely busy supervising or undertaking mechanical repairs while the vessel is docked: any damage sustained on the voyage must be attended to; worn valves and other components are replaced; main engine bearings are examined; diesel engines may be stripped down; drive shafts and similar mechanisms are repaired; and the generators, alternators and other electrical equipment overhauled.

Preparation and Training: All marine engineers on ships of Canadian registry must be certificated in accordance with regulations administered by the federal Department of Transport. Certificates are issued for work on steam plants, internal combustion engines (usually diesel), or a combination of both. In addition, watchkeeping certificates are required on motor-driven fishing vessels above a certain rating.

Young men interested in marine engineering are advised to obtain a copy of REGULATIONS RELATING TO THE EXAMINATIONS OF MARINE ENGINEERS which details certificate requirements (available in public libraries or can be purchased, price 75c, from the Queen's Printer, Ottawa, or regional bookshops listed on page 2 of this booklet).

The number of engineers on a ship depends on its tonnage, the type of power plant and the class of voyage. On an average steam ship (5,000 tons), there would be a chief engineer (with second-class certificate), a second engineer and two or three assistant or shift engineers with third or fourth-class certificates).

oto: N.F.B. 97114

Above and centre: the engine room of the icebreaker "Sir John A. Macdonald"

Below: engineers check exhaust temperatures and other engine conditions

Photo: N.F.B. 69796

Entry requirements for a career in marine engineering include good standing in mathematics and sciences (preferably high school graduation). Pre-employment courses are available, or being added to the curricula, in the schools at St. John's (Nfld.) Rimouski (P.Q.), Toronto (Ont.) and Sydney (N.S.). Periods of machine shop experience or specified time aboard ship are then required as indicated in the following summary from the Department of Transport regulations for a Fourth Class certificate:

(a) 36 months as apprentice machinist in the repair or manufacture of internal combustion engines; *or*

(b) 36 months as engineer-on-watch on steam ships (10 nominal horsepower or over) or motor ships (75 brake h.p. or over); *or*

(c) 36 months as oiler-on-watch, steam ships (36 horsepower or over) or motor vessels (170 b.h.p. or over); *or*

(d) 48 months as fireman-on-watch on steam ships (16 horsepower or over or 18,000 cubic inches cylinder volume) or motor ship with auxiliary boiler (heating surface over 1,000 square feet).

In addition, candidates for certificates must complete oral and written examinations in subjects listed as Engineering Knowledge—General and Engineering Knowledge—Steam (or Engineering Knowledge—Motor).

Apprenticeship training schemes for machinists are administered in most provinces by the Departments of Labour. During this time the apprentice must obtain employment in a shipyard or engine repair depot and is also required to attend trade schools during each year of apprenticeship where he will be taught shop mathematics, drafting, science and the use of precision measuring tools.

Further progress depends to a great extent on the efforts made to continue studies; correspondence courses are available while aboard ship or "part-year" (from early January to the opening of navigation) and "full-year" (classes held throughout the year) may be

pursued. The following institutions currently offer courses in marine engineering:

College of Trades and Technology,
Marine Engineering Section,
St. John's, Newfoundland.

College of Fisheries,
Navigation and Engineering Section,
St. John's, Newfoundland.

Institute of Technology,
Marine Engineering School,
Halifax, Nova Scotia.

Marine School,
Department of Education,
Rimouski, Quebec.

Montreal Technical Institute,
200 Sherbrooke St. W.,
Montreal, Quebec.

Provincial Institute of Trades,
37 Dartnell St.,
Toronto, Ontario.

Vocational Training Institute,
Marine Engineering Section,
Department of Education,
Vancouver, British Columbia.

Training College for Canadian Coast Guard, Sydney, Nova Scotia.
Scheduled to open 1965.

It is extremely important that young men contemplating careers in marine engineering select the proper courses of study and, later, are guided in their machine-shop training and sea-going experience. The recommended preliminary step would be an interview with the school guidance counsellor (this, of course, applies to all occupations described in this booklet). Visits to ships and, if at all possible, a sea-going voyage should be made. Qualified marine engineers in government service offer to provide advice on career planning and serious applicants can obtain further information by writing to: The Chairman, Board of Steamship Inspection, Department of Transport, Ottawa, Ontario.

Working Conditions: vary with the age of the vessel, the type of power plant and the class of trade carried but on all ships working and living quarters are of limited size. Junior engineers must be prepared for strenuous work while aboard ship and will have to become accustomed to a great deal of noise, heat and fumes on the few remaining coal-burning vessels; in modern ships powered with diesel engines these conditions are somewhat reduced.

When the junior engineer has acquired sufficient experience he will be placed on "watch" (on duty) and to make a success of the job needs reliability, alertness and common sense under ordinary conditions plus the ability to cope with any emergencies which may arise; in turn, an engineer has the personal satisfaction of keeping powerful machinery at maximum efficiency through his own skilled efforts.

During the shipping season, which on Canadian waters is from nine to ten months depending on weather and ice conditions, the usual practice is to divide the day into six, 4-hour watches, seven days a week. The engine room and deck staff normally stand watch for four hours and then have eight hours off giving an average work week of 56 hours. There are regular shore leaves but prolonged absences from home base can be expected.

Advancement: This depends on the determination to obtain the required certificates and progress can be fairly rapid to second engineer. Promotion to chief engineer may be more difficult since openings depend on the shipping company and the number and size of vessels they operate, and on general conditions in the industry; however, some chief engineers have reached their position by their thirties.

For those who decide to take up employment on land there are managerial and administrative positions in marine inspection services, federal government, shipbuilding and repair yards, and with insurance companies. Related occupations in stationary engineering, diesel-engine servicing, machining and similar fields are other possibilities.

Future Outlook: Marine engineering is not a large field of employment (there are approximately 3,500 active certificated engineers) and has shown relatively little increase over the past ten years. However, the supply of qualified engineers has rarely been sufficient to meet the demand and, in government service, a shortage of engineers in the Coast Guard Service is anticipated until a sufficient number of cadets graduate from the Coast Guard institution to be established at Sydney, Nova Scotia.

INDUSTRIAL REPAIR OCCUPATIONS

As previously mentioned, many mechanics and repairmen are employed in manufacturing, industrial and similar establishments or in the railroad, marine and other branches of the transportation field. Related occupations such as machinists, sheet-metal workers, blacksmiths, welders and other maintenance craftsmen are described in another booklet in this series—METAL WORKING OCCUPATIONS.

Many industrial repairmen are specialists, either in one branch of mechanical repair or on one type of machine only, particularly in larger companies where the volume of work is sufficient to permit division of the general repairman's duties. For example, in the pulp-and-paper industry there is a "knife setter" who dismantles and repairs machines which reduce logs into wooden chips; a "car knocker" (railroad industry) repairs metal tank cars used to transport bulk petroleum products, and there is a "napper grinder" (textile industry) who sharpens the wire teeth of a cotton carding machine. These specialists, and many of the others, have been selected for their mechanical ability from other jobs within a manufacturing plant, and are trained for a particular job by their employer.

Of the several hundred mechanical repair occupations, a number have been selected for description which will be found in several different industries or where the skills, as a general rule, can be transferred from one field of work to another.

Although all mechanical repairmen require an interest and ability in mechanics together with skills in the use of hand or machine tools, a few of those in manufacturing or similar companies are employed under a somewhat different set of working conditions than repairmen in trade and business occupations. Several of the occupations about to be described may appeal to those who prefer to work as part of a team in a fixed place of employment and may be interested in such features associated with a large organization as holidays with pay, pension schemes and recreational facilities. In contrast, repairmen in trade and business occupations often work alone (or with a single helper), must make many decisions, and their work usually involves considerable travel; they do, however, have more opportunities to become self-employed by opening their own businesses.

Millwright (Industrial Mechanics)

The term "millwright", originally used to describe craftsmen who designed and set up machinery in such places as the sawmill and the grist mill, soon became identified with workers who, in addition to installing machinery, were responsible for its repair and maintenance. Their duties often included maintenance of power machinery (perhaps a steam engine or a water wheel) and the structure housing the plant.

Although the present-day millwright has retained some of these functions, with the increasing complexity of modern machinery and industrial processes there is a division of duties: the millwright now tends to concentrate on the erection or relocation of machinery; overhaul or maintenance functions have become the work of industrial mechanics. For ease of understanding, millwrights and industrial repairmen are treated separately in later paragraphs but it must be emphasized that, depending on the type of plant and the employer's policy, there is considerable overlap between their duties.

The principal fields of employment for both millwrights and industrial mechanics are in establishments using production machinery and which have sufficient development and maintenance work to provide employment of a permanent nature. These include primary iron and steel plants, machinery manufacturing concerns and automobile factories, which are concentrated in Eastern Canada. A considerable number are also employed across the country in sawmills and related wood products factories, chemical plants, building or heavy engineering construction firms and in most of the smaller manufacturing plants.

Nature of Work: *Millwrights* are skilled craftsmen who move and install heavy industrial machinery and related equipment. In a typical moving job, the first task is to prepare a foundation at the new site. Concrete may have to be poured into wooden forms or the foundations may be of wood, metal or other materials depending on the type of machine, its weight and function. At the same time, if existing machinery is being moved, securing bolts must be released

and component parts dismantled. This requires skills in the use of wrenches, hammers, screwdrivers and similar handtools and, in addition, the millwright must be able to prepare notes, sketches or drawings for use when the machine is reassembled.

The machinery is then moved by overhead crane, block-and-tackle or similar equipment or transported with dollies, rollers, slings or by truck to the new site. Here the machine is carefully lowered onto the prepared foundation, the alignment is checked with spirit levels, plumb lines or optical devices such as the surveyor's transit and level (trigonometry is needed to calculate adjustments from readings on these devices), adjustments are made as necessary and, finally, the machine is secured to bolts or similar fasteners embedded in the foundation.

Those parts of the machine which were dismantled for ease of transport are then reinstalled from notes or drawings made by the millwright, or from manufacturer's drawings if available, and such features as bearings are fitted, shafts installed and aligned, belts spliced and connected, and motors attached. Additionally, any parts found to be below standard during dismantling operations are replaced from stock or may be repaired by the millwright.

In moving heavy machinery, the millwright uses considerable ingenuity to plan the method and sequence of operations and must select lifting and other tackle. The ability to proceed independently without direct supervision or instruction is required and, at all times, safety codes and practices must be understood and observed. To reinstall those parts which were dismantled and to put the machine into operating condition requires the ability to use handtools and micrometers, verniers, dial indicators or similar measuring devices, a thorough understanding of the machine, its function and method of operation.

All the foregoing work may be done by the millwright on the payroll of the industrial plant, assisted by a few labourers, or the millwright may be in a supervisory capacity over a team of craftsmen: alternatively, when new machinery is purchased, installation may be done by a team of engineers or technicians, millwrights, fitters, electricians and other workers sent to the plant by the machinery manufacturer.

As previously mentioned, millwrights may have other duties in addition to relocating machinery; they may repair or maintain conveyors, pumps, cranes, hoists and similar industrial equipment; oil and grease machinery; repair belts and shafting; or may form part of a team undertaking preventive maintenance routines to keep a production line operating. From this it will be seen that the millwright must be versatile, skilled in drafting, and requires a knowledge of machining, fitting practices, pipefitting and electrical work or, at least, must have sufficient knowledge of building codes, safety regulations and job requirements to supervise workers in these trades.

Industrial machinery mechanics are responsible for servicing, repair and overhaul of machinery and mechanical equipment used in manufacturing and similar plants; they are known by many other titles including maintenance machinists, machine repairmen or maintenance mechanics and, as previously indicated, repair and overhaul work may be included in the duties of millwrights.

The nature of work undertaken by mechanics shows considerable variation and depends largely on the types of machine used in a particular plant. In an automotive plant, for example, "heavy" machines such as stamping presses, drop hammers, multiple drills, millers and automatic lathes are used which, in addition to demanding high standards of workmanship and mechanical ability, also require a knowledge of hydraulic, pneumatic and electrical principles; in a box-making factory, there are machines to cut, fold, staple and label boxes in a continuous operation which rely on complicated geometrical mechanisms; and the intricate knitting and weaving machines used in textile factories must be serviced to limits of accuracy measured in thousandths of an inch. In other plants, of course, the machinery may be relatively simple and here millwrighting is usually combined with machinery repair work.

All mechanics are engaged in preventive maintenance routines, emergency repair services and major overhaul. To keep machinery operating and thus avoid costly stoppages, the industrial mechanic normally follows a routine maintenance schedule supplied either by the machinery manufacturer or, as is more usual, developed in the repair shop.

Photos: CANADIAN PACIFIC

Some aspects of removal and assembly

Above: a generator is positioned ready for installation

Centre: aligning a drive shaft

Below: fitting a drive assembly

Photo: N.F.B. 93796

Periodically, the machinery is lubricated and examined for excessive wear and signs of other defects which could lead to serious breakdowns. Less frequently, some dismantling is done to allow a more thorough examination of the components or so that they may be changed. The mechanic also records routine servicing and other information for use should a breakdown occur.

Although the foregoing routines are designed to keep breakdowns to a minimum, abnormal conditions such as incorrect operation, excessive strain and metal fatigue result in stoppages. The mechanic is then required to use considerable ingenuity to diagnose the fault and to get the machine back into production. Relying heavily on mechanical ability plus practical experience, the mechanic makes adjustments, repairs defects or installs replacement parts. Dismantling of the machine may be required and a thorough knowledge of its principles of operation, skills with handtools—wrenches, screwdrivers, hammers and specially designed tools—together with the ability to use micrometers, dial indicators, sine bars and gauges are necessary. Other skills such as welding and brazing may also be required. At major overhaul periods, the machine is usually completely dismantled, parts are examined for defects, repairs undertaken or replacements made as necessary.

As far as is practical, a stock of replacement parts is maintained in the repair shop and the mechanic is responsible for ordering parts from manufacturer's catalogues. When parts are not available, they may be made by machinists or other craftsmen using engineering drawings or sketches prepared by the mechanic: alternatively, parts may be made by the mechanic using skills and techniques normally associated with the craft of machinists (machinists are described in METAL WORKING OCCUPATIONS in this series—*see* inside front cover).

Preparation and Training: Apprenticeship is one of the recognized routes to millwright and industrial repair occupations (page 110). Preparatory courses of two years, full-time instruction are available in a number of technical institutes. Others may have served an apprenticeship as a machinist before going on to repair work, have been trained by an employer to take care of the requirements in a particular plant, or picked up their skills while working as a helper.

Personal Qualities: In addition to mechanical ability and those already described, good eyesight, a keen sense of responsibility and the ability to improvise are necessary; millwrights and some industrial mechanics require above-average strength since, at times, the work demands heavy physical exertion.

Working Conditions: Depending on the type and age of the plant, conditions vary but most jobs are oily or greasy and exposure to such hazards as falls from ladders, contact with high-speed machinery, or those associated with dismantling or moving large and heavy objects will be encountered. These hazards, however, are considerably minimized by strictly enforced safety regulations which often include the wearing of special headgear, steel-capped boots and similar items. In the smaller plants, industrial mechanics (or millwright) may be in sole charge of plant maintenance and will control a group of labourers; in large plants, they work in a group of craftsmen which may number over a hundred.

Advancement: Positions are available, for those who demonstrate ability and leadership, to foreman or maintenance supervisor; other supervisory positions include those concerned with planning and layout of machinery.

Future Outlook: Employment prospects are good for those who are highly skilled; a moderate rise in employment opportunities, in addition to normal openings which arise from retirement or movement to other fields of work, is indicated over the next decade. This is based on the continued introduction of machines and mechanized processes or the substitution of machines for hand labour. It should be noted, however, that newer machines incorporate electrical and electronic systems, hydraulic, pneumatic and similar controls, and are manufactured to extremely high standards of accuracy; in consequence, workers of average ability may find their employment prospects limited.

Gasfitters

At the present time, about 15 per cent of the energy used across the nation for heating and similar services in commercial, industrial and domestic establishments, and for such purposes as electrical power generation or blast-furnace operations, is obtained from gas-burning installations (chiefly natural gas).

Commercial and industrial gas-burning systems are installed and maintained by licenced general gasfitters who are employed by gas utility and private companies; this work is similar in many respects to that of construction plumbers and pipefitters and, in fact, may be an extension of these trades. Pipefitters and other construction workers such as electricians (who install heating system motors, wiring, controls and other electrical components), sheet-metal workers (who are concerned with ducting and venting) and design or technical staff are described in the booklet CAREERS IN CONSTRUCTION in this series (*see* inside front cover).

Domestic systems for home heating or other services may be installed and later, maintained by the same general gasfitter; alternatively, gas utility companies and, also, home-heating and plumbing contractors may employ maintenance and repair personnel who are licenced to work on domestic systems only.

Nature of Work: Typical of the domestic gasfitter's work is the installation in a home under construction of the piping system required for such household appliances as the heating furnace, an automatic water heater, a cooking range and perhaps a gas refrigerator.

The gasfitter measures and marks out the location of holes through which pipes will pass and where outlets must be provided for the gas appliances to be later installed. Before the walls and floor are covered with masonry or wood, the gasfitter (or a helper) attaches metal supports on which are installed main and branch pipelines to carry the gas to various outlet points. These pipes, which are later to be covered, are pressurized and rigorously tested for leaks.

At a later stage in the building program, various gas appliances are installed and connected to the waiting pipes at the outlet points.

system. Further leakage and similar tests are carried out and, finally, the completed installation is attached to the main gas supply line. This can only be done by approved employees of the gas supply company in some provinces.

Installation of the gas-burning appliances and their later servicing, maintenance or overhaul are usually the work of gasfitters who are known variously as appliance mechanics or servicemen, utility gasfitters, heating-system servicemen and by many other titles. There is no clear-cut division between their duties and those of general gasfitters although these are mainly concerned with installation work, other than the limitations imposed by the class of licence held. Of these occupations, the servicing of domestic appliances, a general description of which is given on page 73, and burner-heating equipment (page 84) should prove of interest to the reader examining mechanical repair occupations.

Gasfitting and the maintenance of systems or appliances calls for a variety of skills. For example, pipes are bent with hand-held hydraulic benders or with power machines and are cut with hand or power saws; joints are threaded, brazed or welded* and such handtools as reamers, wrenches, drills, hammers and chisels are in frequent use. In maintenance work, or the testing of a new installation, measuring devices such as carbon dioxide analyzers and voltage testers are used and their readings must be understood. Gasfitters must also be able to read engineering drawings and the manufacturer's installation drawings, charts and tables. Of perhaps the greatest importance is a knowledge of safety practices, Codes such as CSA Standard B149 Installation Code for Gas-Burning Appliances and Equipment, and provincial regulations.

Preparation and Training: Entry into gasfitting occupations shows considerable variation at the present time. In the province of Alberta, entry is through a formal apprenticeship scheme (page 109). In other provinces gasfitters have served an apprenticeship in a related trade such as plumbing and steamfitting, taken additional training and have completed examinations which permit them to follow the trade of gasfitting. Several of the larger gas utility companies also operate apprenticeship-type training schemes for their

*Some provinces have special requirements for welding. In Manitoba, for example, only those holding a welding certificate under the Steam and Pressure Plant Act may weld or braze a vessel connection to any gas equipment.

employees. Pre-employment courses in gasfitting techniques and practices are available in vocational or trade schools and a few institutes of technology.

On completion of apprenticeship or any other form of training, it is necessary to obtain licences (or a certificate, depending on the province) before the trade can be practised. As will be seen from the summary of provincial regulations given on page 53, either a Board of Examiners or a Chief Inspector must be satisfied that the training program has been adequate and examinations, often based on safety codes and practices, must be completed. The various Acts covering licencing requirements are administered by provincial Departments of Labour (except in the province of Quebec where the authority is the Department of Natural Resources and British Columbia—Department of Public Works) from whom detailed information can be obtained by serious applicants.

Working Conditions: On the construction site, the gasfitter may work alone except for an apprentice or may be one of a large group of workers. Here, the gasfitter can expect to encounter adverse weather conditions and the work may be dirty. Maintenance of home equipment presents a different set of conditions; the gasfitter may work on a heating system located in a basement, where lighting conditions are poor, or repair a cooking stove in the kitchen.

Personal Qualities: In addition to mechanical ability, a keen sense of responsibility is most important; gas is safe when correctly handled but careless work or inattention to detail could have serious consequences. Gasfitters, particularly those working around homes, have a minimum of supervision and must be reliable; the ability to meet people and cleanliness, both in work habits and in person, are also necessary.

Advancement: A good line of promotion is available for the licenced gasfitter who is highly skilled and has the ability to assume responsibility as a foreman, an inspector or in similar supervisory positions.

Future Outlook: Prospects for continuing employment are good. Over the next decade, considerable activity has been forecast for the construction industry and this is expected to give rise to a number of new employment opportunities for gasfitters.

PROVINCE	TYPE OF LICENCE OR CERTIFICATE	QUALIFICATIONS REQUIRED	TYPE OF WORK
British Columbia	(1) Grade 2 Licence	Hold Grade 1 Licence for two years (or be a Professional Engineer and have two years practical experience) plus examinations	No restrictions
	(2) Grade 1 Licence	Four years experience plus examinations	Up to 750,000 BTU
	(3) Provisional Licence	Issued at discretion of Board	As endorsed on licence
Alberta	(1) First Class Gasfitter's Certificate	Completion of apprenticeship examination	No restrictions
	(2) Second Class Restricted Gasfitter's Certificate	Issued at discretion of Board where pass mark not obtained	Specified projects only
Saskatchewan	(1) General Gasfitter's Licence	Experience and examinations as required by Chief Inspector	No restrictions
	(2) Domestic Gasfitter's Licence	As above	Domestic installations

PROVINCE	TYPE OF LICENCE OR CERTIFICATE	QUALIFICATIONS REQUIRED	TYPE OF WORK
Manitoba	(1) Commercial and Industrial Gasfitter's Licence	(a) Hold gasfitter's licence for two years and satisfy Board (one year's experience on installations over 400,000 BTU or equivalent) *or* (b) four years experience under direct supervision of licence holder *or* (c) hold plumber's or steamfitter's certificate plus two years under direct supervision	No restrictions
	(2) Domestic Gasfitter's Licence	Two years practical experience(steamfitter or related work acceptable) plus one year under direct supervision and completion of course approved by Board *or* hold licence for two years on oil-burning installations plus experience on gas installations acceptable to Board	Not exceeding 400 BTU
	(3) Utility Gasfitter's Licence	Two years experience and course of training acceptable to Board	As (2) above in course of employment with gas utility.
	(4) Liquid Petroleum Gasfitter's Licence	One year experience in related trade acceptable to Board plus course on petroleum installations	Liquid petroleum (single installations) up to 125,000 BTU
	(5) Special Gasfitter's Licence	Satisfy Board on knowledge of specified equipment	As specified on licence only

PROVINCE	TYPE OF LICENCE OR CERTIFICATE	QUALIFICATIONS REQUIRED	TYPE OF WORK
Ontario	(1) Gasfitter's Licence	Experience, examinations (based on Canadian Standards Association CSA B149) and safety practices	No restrictions
	(2) Maintenance Gasfitter's Licence	As above	Maintenance of commercial or industrial installations
	(3) Low Pressure Gasfitter's Licence	As above (emphasis on CSA B149, Part 3)	Liquid petroleum installations
Quebec	(1) Contractor's Licence	Hold journeyman's licence and obtain registration as contractor	*Note: Legislation is pending which requires those working on gas systems or appliances to hold a Certificate of Competency. Certificates based on written and oral examinations (with emphasis on Code ASA B31.8-1963 published by the American Society of Mechanical Engineers) are issued by the Electricity and Gas Board of the province of Quebec to successful applicants. Ref.: Order-in-Council No. 1491.*
	(2) Journeyman's Licence	Completion of 4-year apprenticeship and examinations prescribed by provincial Board	
	(3) Apprentice's Licence	Completion 8th grade primary course or examination to prove equivalent	

Note: Most of the foregoing licences must be renewed annually at a fee of approximately \$5 to \$10.

Refrigeration and Air-Conditioning Mechanics

Refrigeration, heating and air-conditioning systems in domestic, commercial and industrial establishments are installed and maintained by a group of highly skilled craftsmen who are known under the collective title of refrigeration and air-conditioning mechanics.

The main fields of employment are in the larger population centres with construction contractors, equipment manufacturers or dealers, and in a number of shops which specialize in repair and maintenance services only. Refrigeration and air-conditioning mechanics are also on the payroll of commercial and industrial establishments large enough to employ their own maintenance staff and in the marine, road and railway branches of the transportation industry.

The scope of activities in these fields is so varied that there is considerable specialization among the workers. Home-heating systems (these can be considered as winter air-conditioning systems), which often incorporate humidifiers or cooling units, may be maintained by the home-heating (domestic) servicemen described on page 82. Commercial installations such as are used for beverage coolers or display cases for meat, dairy products, fruit and so on are equipped with sealed units designed in such a way that they are interchangeable and can be maintained by appliance servicemen (page 78).

It is in the installation and maintenance of commercial or industrial systems where most of the opportunities exist for qualified refrigeration and air-conditioning mechanics. Refrigeration plants are used in dairies, meat-packing houses, curling rinks, warehouses and similar establishments (it should be noted that refrigerating plants above a certain capacity can only be operated by licenced personnel—see the section dealing with stationary engineers for further details). Air-conditioning systems are used to wash, temperature control, clean and humidify such industrial plants as instrument-making laboratories, or to maintain suitable temperatures in theatres or other large buildings where people congregate. Both

refrigeration and air-conditioning systems have features in common and the work may be considered as a single activity; however, certain employers specialize in one of the two phases and, for ease of understanding, the work is described separately in the following paragraphs.

Nature of Work: *Refrigeration mechanics* are in work similar to that of gasfitters (described in preceding paragraphs), plumbers or pipefitters. From engineering drawings and other instructions, the mechanics install pipelines, usually of copper or stainless steel, through which the refrigerant will pass, and make threaded, soldered or brazed joints; regulators, pressure control valves and similar components are also mounted in the lines. Pumps, compressors, condensers and other refrigerating units are secured to prepared foundations and are then connected to the pipelines. Electrical motors, switches, sensing units and other electrical components are installed and connections are made to electrical power sources. Finally, the installation is completed by connecting gauges, indicators and recording devices (where the indicating and recording system is complicated, an instrument mechanic may be involved).

After completing the installation, the mechanic tests piping joints for leaks and adjusts various components, the system is charged with refrigerant and final adjustments are made to ensure the most efficient performance.

Air-conditioning mechanics work on two general types of equipment: "packaged" units and remote installations. Packaged units, as the name implies, are self-contained within a single cabinet and come in various sizes from small units used to cool a room to the large size in restaurants, stores and so on. Remote installations have similar components but these are usually much larger, are placed outside the space to be cooled and air ducts lead to the conditioned space.

Installation work is similar to that for refrigerating plants in that components are installed in accordance with engineering drawings; however, sheet-metal ducting is used and the mechanic requires a knowledge of ducting systems such as setting air registers, vents, dampers, grills, diffusers and special air-balancing or mixing units. This is in addition to the knowledge required of air-conditioning

components including electronic air cleaners, humidifiers, filter banks, odour absorbers and the automatic controllers which range from simple on-off switches to complex systems incorporating electrical, pneumatic and combined sensing elements together with their corresponding actuating devices.

Maintenance procedures on both refrigeration and air-conditioning systems are similar and include periodic lubrication, replenishment of refrigerant, leakage tests, replacement of filters, adjustment of valves and other components and examinations to locate defects before they develop into serious trouble.

Should a breakdown occur, the refrigeration and air-conditioning mechanic must diagnose the cause and makes tests with such instruments as thermometers, commercial leakage testers, hygrometers, flow meters, pressure gauges, voltmeters, vacuum pumps and electrical test equipment.

Although refrigeration and air-conditioning mechanics specialize in certain phases of work, there are requirements all must possess. These include skills with handtools together with the ability to use soldering and brazing torches, power tools and the test equipment already given. In addition, a knowledge of pipefitting practices, sheet-metal work and building codes is necessary.

Analytical ability based on the principles of refrigeration and air-conditioning is demanded together with training in mathematics (areas, volumes, velocity, power transfer, temperature and fluid-flow calculations are important) and sciences (hydraulics, pneumatics, electricity and chemistry of gases).

Preparation and Training: Apprenticeship is the minimum training requirement for refrigeration and air-conditioning occupations (page 110). It should be noted, however, that air-conditioning plants for commercial and industrial uses are becoming increasingly complex and persons with advancement in mind should investigate the training courses offered in institutes of technology; details of this type of training are given in the booklet, TECHNICIANS IN SCIENCE AND ENGINEERING, in this series.

Working Conditions: Generalizations only can be given owing to the wide variety of jobs the mechanic will encounter. Basically, conditions are similar to those of gasfitters which have already been outlined; all mechanics must be prepared to get their hands dirty and, at times, heavy physical effort may be required. A keen sense of responsiblity is necessary and great attention must be paid to detail.

Advancement: In repair and installation work, positions such as foreman or supervisor are available. Other areas for those who have taken additional training include lay-out or drafting, estimating, cost analysis and correcting technical difficulties; ownership of a private business is another possibility.

Future Outlook: Employment opportunities over the next decade appear excellent for those with above-average skills and knowledge of refrigerating and air-conditioning principles. Almost 80 per cent of the food now consumed across the nation relies on refrigeration for processing, storage, transportation and retailing to the consumer; these installations require periodic maintenance or replacement as they become outdated. A few of the many industries which now consider air-conditioning a necessity include textile manufacturers, printing plants, photographic material suppliers, instrument manufacturing and repair companies and candy makers—and the list continues to grow.

Instrument Repairmen

A wide variety of instruments are used to measure speed, weight, flow, specific gravity, temperature, density and other phenomena for the control or perhaps "automation" of various industrial processes. These instruments incorporate mechanical, hydraulic, pneumatic, electrical or electronic principles and, as will be realized, provide a field of work for maintenance and repair personnel in jobs requiring mechanical ability and manual dexterity—skills with the hands—although a knowledge of related sciences is necessary. However, the reader who is interested in the application of the principles of instrumentation, as distinct from mechanical repair work, is referred to TECHNICIANS IN SCIENCE AND ENGINEERING in this series which describes careers requiring post-high school education and training.

Employment will be found in most industrial and scientific establishments, in addition to plants which either make instruments or provide repair and overhaul services; these plants are usually located in major population centres. A partial list of employers would include petroleum refineries, pulp and paper mills, electrical or gas utility companies, the automotive industry, chemical plants, aircraft repair depots, the Armed Forces and in government service.

Instrument repairmen is the term applied to workers in routine functions where the fundamentals can be learned by experience and, once they are learned, can be repeated without going into a theoretical analysis for each job. There are many other occupational titles including instrument mechanic, meter repairman, instrument serviceman and instrument technician; the latter is advocated for use by such organizations as the Instrument Society of America. Even within this group there is considerable specialization usually depending on the nature of industry in which the repairman is engaged: some may specialize on capsule-operated instruments (aircraft altimeters or barometric equipment), on civil engineering equipment (theodolites, levels and photogrammetric instruments) or on time-keeping instruments only.

Nature of Work: In general, instrument repairmen work in two main areas: (1) as part of the team which installs instrumentation systems or modify and "trouble-shoot" those already existing and (2) on the bench where they overhaul instruments and related equipment.

Installation and modification of instrument systems is the work of engineers, technicians (these may be trained in mechanical, electrical and electronic, chemical or other technologies) and specialist craftsmen. The instrument repairman, under direction, will be involved in any of the following functions: mounting instruments and making connections to hydraulic, pneumatic and electrical transmission lines; checking for liquid or air leaks in pipelines and electrical circuits for continuity; calibrating the system; and making adjustments to ensure correct operation of the completed installation.

Trouble-shooting is undertaken by repairmen in accordance with established procedures and consists of visually inspecting components, pipelines and connections for defects and using test equipment such as vacuum and pressure gauges, speed counters, voltmeters, ammeters and potentiometers to locate trouble.

It is in the overhaul of instruments on the bench where the repairman's skills are in the greatest demand. Here the instruments are cleaned, dismantled, tested, adjusted and calibrated as detailed in maintenance manuals normally provided by the instrument manufacturer.

Personal Qualities: The repair of industrial instruments requires the ability to use small handtools such as tweezers, eyeloops and jeweller's screwdrivers together with machine tools including grinders, polishers, drills and the watchmaker's lathe. Essential personal qualities include steady hands and a keen sense of touch plus the ability to concentrate for long periods of time on minute work. General health and eyesight (either normal or corrected) must be good but there are no required physical standards since the work is not considered strenuous.

Working Conditions: In industrial plants, the repairman will meet existing conditions of heat, fumes and noise but the instrument department is often away from the main plant, is clean and usually air-conditioned.

Preparation and Training: Entry into instrument repair occupations at the present time shows considerable variation. In several provinces, apprenticeship training programs are available (page 110). Other repairmen have moved from training in such crafts as watchmaking while a few have picked up their skills during employment as helpers. Preparatory courses in algebra, trigonometry, physics, chemistry, machine-shop practices and blueprint reading increase the chances of obtaining an apprenticeship. It should be noted that the field of instrumentation is becoming increasingly complex and those with advancement in mind should make every effort to obtain a recognized apprenticeship or might consider the training offered through courses in institutes of technology.

Advancement: As with most industrial occupations, advancement depends on the efforts made to keep up with the latest technical changes, both in instrumentation and in the processes carried out in the place of employment. Positions as foreman or inspector are available and further training could lead to more highly paid careers in drafting, mocking up new installations, lay-out work, investigating technical faults, or obtaining and interpreting scientific or technical data.

Future Outlook: Employment opportunities will depend on the rate of introduction of automation; when a number of instrumentation systems are brought together under a master control, this is automation. When the automated factory arrives, the number of personnel in instrumentation servicing and maintenance will increase and a good future is indicated over the next decade for well-trained repairmen; currently the use of instrumentation is increasing and there are some shortages from time to time for highly skilled workers.

Elevator Mechanics

The increasing numbers of high-rise buildings which have been constructed in the post-war years for industrial, commercial and residential use have created a corresponding increase in the demand for a variety of conveniences and adequate facilities. Of these, the equipment used for vertical transport (passenger or freight elevators and dumb-waiters), inclined lifts (escalators), chair lifts and ski tows, provides a field of employment for elevator mechanics.

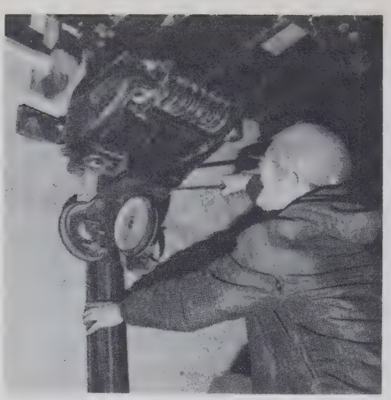
Elevator mechanics are employed mainly by equipment manufacturers who, in addition to installation services, also provide maintenance, overhaul, and emergency services on a contract basis. Others are employed by local contractors specializing in maintenance, are on the payroll of business establishments and government agencies as repairmen, or are with provincial government departments as inspectors to enforce safety and other regulations.

Nature of Work: Assembly and the installation of transport systems in a building is the work of a crew of *construction mechanics* or *elevator constructors*. On arrival at the building site their first job is to install the guide rails in the elevator shaft on which the passenger or freight car and its counterweight will travel. At the same time, others in the crew install the motor generators and associated driving and braking mechanisms, either in the penthouse at the top of the elevator shaft (this may be several hundred feet above street level) or in a confined machine room adjacent to the bottom of the shaft.

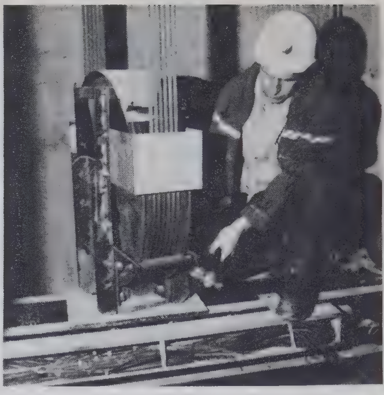
The car and its counterweight are fitted on roller guides to guide rails and the hoisting cables are attached to the top of the car, over the driving mechanism, to the counterweight. After these major components have been installed, many other items including electrical motors, relays, safety and limit switches, signalling systems, door-operating mechanisms and the electrical wiring are added.

When the installation has been completed, final adjustments are made to the cables and to various components thus ensuring safe and efficient operation; for example, relays are synchronized for

Photos: OTIS ELEVATOR CO.

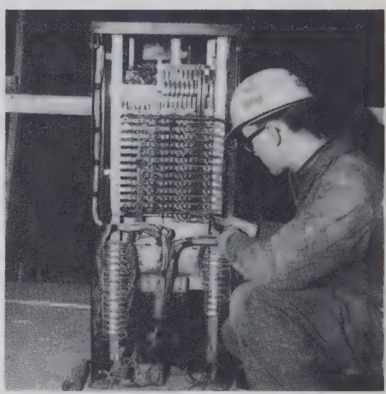


Elevator constructors install roller guide wheels

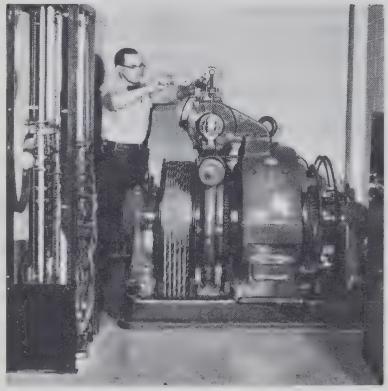


Aligning the rotable sheave calls for extreme accuracy

Securing guide rails in the elevator shaft



A sound knowledge of electricity is required to test this bank of selectors



Periodically, adjusters examine or test the braking coils

Complex electrical installations govern the operation of an elevator

smooth operation, braking mechanisms adjusted to ensure positive and gentle stops, and such features as load-weighing switches are tested for correct functioning under varying loads. Owing to the nature of these adjustments—often the equipment has a high electrical and electronic content—this may be done by a specialist adjuster who also makes periodic visits to buildings where elevators are already in operation.

Finally, the installation is examined and tested for compliance with the Elevator Safety Code; this is the work of government inspectors who, in many provinces, also make annual safety checks.

Servicing and maintenance of transport systems already in operation depends on the policy of the building owner. Maintenance of simple systems, at present, is undertaken by general electricians or mechanics, the building supervisor and by others. However, the complex electrical and mechanical assemblies which comprise a modern elevator system demand the services of personnel with a thorough understanding of the specialized equipment and its interrelated operation. It is therefore the usual practice for a maintenance contract to be made between the owner of the building and the manufacturer who originally installed the system.

Contract maintenance is the work of *examiners* in an assigned area and who are selected for their electro-mechanical knowledge and other factors including personal appearance, manner and the ability to maintain good customer relations.

At frequent intervals—weekly, monthly and so on—the examiner will clean and lubricate moving parts, examine, test, adjust and replace various components in accordance with procedures detailed in the manufacturer's maintenance manuals. Typical jobs to ensure safe and efficient operation include the following: the many switches and relays which control doors, signal lights and operating systems are examined for correct operation; the floor selector controlling the automatic operation of the elevator is tested for correct functioning; electronic door selectors are adjusted for sensitivity; such features as braking coils, the bearings of each driving machine and the operating cables are examined for excessive wear.

The work of an examiner is usually limited to lubrication, adjustments and minor repairs; specialized personnel such as *adjusters* undertake the more complex types of setting and adjustment. Should a major defect be found by the examiner (or an emergency call made by the owner) it is the usual practice for these to be handled by service repair crews assigned by a service superintendent.

Installation and repair jobs require skills in the use of wrenches, screwdrivers, pliers, drills and similar handtools and rulers, micrometers, verniers, ohmmeters, voltmeters and other measuring devices. The mechanics must also understand the techniques of soldering, welding (in some provinces welders must be approved), pipefitting and steel fabrication. Additionally, such personnel as adjusters use complex electronic test equipment; for example, a cathode-ray oscilloscope is required to synchronize relays and associated circuits.

Personal Qualities: Mechanical interest and ability are important as is a sound knowledge of electricity and electronics, hydraulics and pneumatics together with the ability to read and understand mechanical drawings and electrical wiring diagrams. It should be noted that elevator mechanics, particularly testers and adjusters, require a deeper knowledge of electricity than most of the other repairmen described in this booklet.

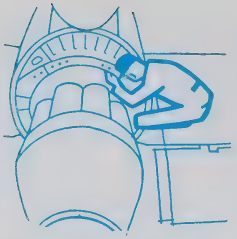
Working Conditions: On a building site the construction mechanic is exposed to extremes of weather and there is much bending, climbing and lifting, all of which demand a sound physical condition; working at heights on a new structure also requires a good sense of balance. There is considerable movement from one construction site to the next—it takes about 12 to 14 weeks to install an average elevator—after which the mechanics go on to the next job.

Repairmen and examiners are employed in completed buildings, are protected from the elements and their jobs are less strenuous than that of the construction group; they do, however, often work in cramped and confined areas. Considerable travelling is involved throughout an assigned district and the repair group are "on call" outside normal working hours. One or two days may be occupied at each elevator site and an examiner then travels (usually by public transport) to the next building.

Preparation and Training: Training programs are provided by elevator manufacturers who expect applicants to have completed high school with a sound background in mathematics, physics and similar subjects. Company training takes from two to four years during which time the learner is assigned for a period in the manufacturing plant and is then sent as a helper to acquire skills on the construction site or vice versa. Further mathematics, physics (including electronic theory) and vocational subjects must be studied on a part-time basis; financial assistance may be given by the employer. As with most repair occupations, the apprentice is required to purchase a kit of handtools during the training period.

Advancement: Opportunities include foreman, adjuster, supervisor, service superintendent, sales representative and management. Positions are also open as inspectors with government agencies and with a few insurance companies. Entry into government employment is based on practical experience (from 5 to 10 years) and written examinations.

Future Outlook: Over the next decade, increases in the number of elevator mechanics can be expected from the forecasted growth in the number of multi-storey buildings to be constructed. In addition, the increasing complexity of modern high-speed elevators is expected to increase the number of mechanics in the industry. However, it should be noted that the number employed in this occupation is small—there are about 900 mechanics and 600 helpers across the country—and the total of job openings will be relatively few.



Aircraft Mechanics

The pioneering role of the bush pilot and the private operator in opening up the Northwest Territories and the northern areas of Manitoba, Ontario and Quebec is almost legendary. Due mainly to their efforts, the aircraft has become one of the most important features in the development of Canada.

To perform their many and varied roles, safely and efficiently, it is necessary to maintain aircraft both structurally and mechanically sound. This provides a field of work for mechanics who have both power plant and airframe maintenance experience. Related tradesmen such as electricians, radio-radar technicians, instrument technicians, propeller repairmen, sheet-metal workers, machinists and welders carry out specialized work which is usually beyond the capabilities of the mechanic.

Although mechanics and related tradesmen are highly skilled in aircraft maintenance and overhaul, to ensure complete safety, their work must be inspected and certified by personnel who are licenced as aircraft maintenance engineers. In the paragraphs which follow, aircraft maintenance engineers are mentioned to show their relationship with mechanics; a more detailed description is given on page 73.

The main fields of employment for servicing and maintenance personnel are with airlines, independent repair and overhaul depots, government agencies and aircraft factories. These are mainly located near Vancouver, Edmonton, Winnipeg, Toronto, Montreal and Dartmouth (N.S.). In addition, there are many small operators particularly in the North, flying schools, government agencies and a few business establishments which operate their own repair bases.

Nature of Work: In the larger overhaul depots the work is carried out by aircraft mechanics or related tradesmen and inspected by members of the inspection department and who are usually licenced aircraft maintenance engineers: small aircraft charter operators or repair shops employ an aircraft maintenance engineer

who services and certifies the company operated aircraft. Basically, however, all personnel are either in servicing and maintenance of operating aircraft or carry out overhaul work.

Aircraft mechanics undertake aircraft servicing and maintenance as detailed in Servicing Schedules, Descriptive and Maintenance Manuals, Repair and Overhaul Instructions and Service Bulletins prepared by the aircraft manufacturer. It is the responsibility of licenced engineers to ensure that these instructions are correctly followed and to make the various tests which ensure the airworthiness of the aircraft. In the publications are detailed sequences of operations which must be carried out at certain intervals—before flight, after flight, weekly, monthly or other periods such as a stipulated number of flying hours.

Before flight, the mechanics make an extensive examination of the aircraft for damage and obvious defects; such features as the fuel and oil contents are checked; the landing gear including the wheels and tires are examined for wear and damage; flying controls are tested for correct functioning; the engine may be ground run to check oil pressures, temperatures and other indications of engine performance, flight instruments and the electrical power supplies. "Before-flight" servicing by the mechanics is under the direction of an engineer licenced in Category "A" (for fixed wing aircraft or Category "R" for rotary wing aircraft) who, when satisfied with the work, certifies the aircraft by signing the log-book—this contains a history of all work done on the aircraft. On completion of a flight, the mechanics again service and examine the aircraft and rectify any defects reported by the flight crew.

In overhaul depots, the mechanics undertake major servicing and repairs to the aircraft, make modifications as detailed by the manufacturer, and may change the role of the aircraft by fitting skis, floats or additional seats.

At major servicing periods, the mechanics' duties consist mainly of removing units or defective parts which they replace with new or reconditioned items. Units which have been removed are overhauled in separate shops by mechanics specializing in such functions as engine overhaul, landing gear assembly and testing, hydraulic

and other piping system overhaul, radio and radar servicing, instrument repair, welding or sheet-metal work. Other specialist shops carry out such work as tire and brake repair, painting, upholstering and woodworking.

Installation and reassembly on the aircraft must be done under the direction of licenced engineers who also examine reconditioning work while in progress in the specialist shops. A licence in Category "B" is required to certify the airworthiness of an airframe after major overhaul and in Category "D" to certify the engines.

As will be realized from the foregoing description, the functions of removal and assembly require skills in the use of handtools including hammers, mallets, standard and special wrenches, screwdrivers, files and pliers together with rules, micrometers, calipers, gauges and other measuring tools. Power tools including riveting guns, drills and wrenches, are in frequent use. The ability to understand the instructions and diagrams in the publications previously mentioned, installation and similar drawings and Service Bulletins is also required. Of the greatest importance is a knowledge of the function, purpose and method of operation (so that faults can be diagnosed) of various systems—fuel, oil, hydraulic, de-icing, pneumatic, flying control and so on—and of engine starting, combustion, induction and related systems. Subjects also to be studied include physics (electrical and electronic theory), chemistry (types of metals, corrosion causes, etc.), drafting (to make a technical report) and related mathematics.

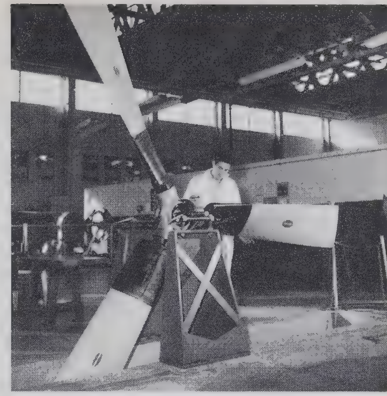
On completion of repairs or overhaul, or when any major component such as a wing has been disturbed, the aircraft must undergo an extensive series of tests before recording and certification in the log-book by the maintenance engineer.

Working Conditions: Repair and overhaul depots are usually heated and well lighted. Emergency and other services also have to be provided on the airfield where the mechanics, engineers and other ground staff are exposed to seasonal weather conditions; these can be severe when operating in the North.

Photo: DEPARTMENT OF TRANSPORT

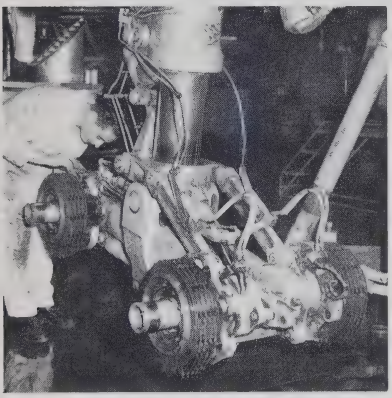
Aircraft repair hangars are heated and well lighted

Photo: CANADIAN PACIFIC



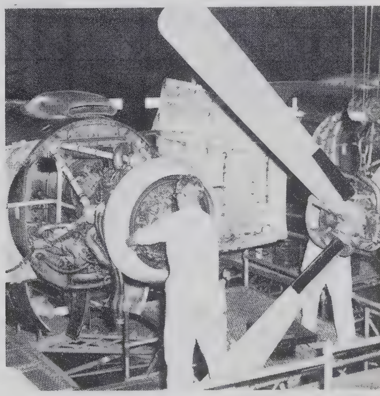
Propeller balancing is one of many maintenance functions

Photo: R.C.A.F. "ROUNDEL"



An engineer examines brake discs after overhaul

Photo: R.C.A.F. "ROUNDEL"

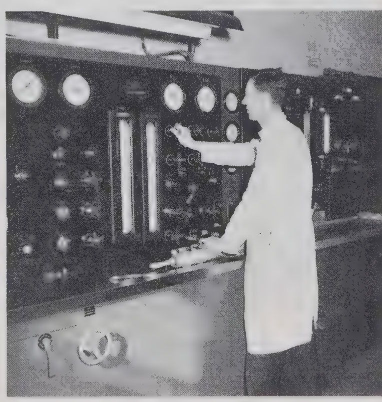


Checking propeller shafts is also part of the engineer's work

Photo: CANADIAN PACIFIC

A mechanic prepares to assemble a piston engine after overhaul

Photo: CANADIAN PACIFIC



Operation of this test rig demands a sound knowledge of hydraulics

Personal Qualities: All maintenance personnel lead strenuous lives and there is much bending, kneeling, stooping and stretching for which a good constitution is necessary. There are the occupational hazards associated with rotating propellers, jet exhausts, air intakes and noises during engine run up and, in the shops, with rivet guns, grinders and similar machine tools. The average work week is about 40 to 44 hours; however, most airlines provide transportation on a round-the-clock basis and shift work is common.

Preparation and Training: The method of entry in the province of Nova Scotia is through a registered apprenticeship scheme (page 110). Elsewhere most aircraft mechanics are trained by the employer —airlines, independent repair shops and aircraft manufacturing concerns. High school graduation with good standing in mathematics (including some algebra and geometry), physics and chemistry together with related training in a trade school are desirable entry requirements. During the training period the learner must purchase various handtools; a basic kit costs between $100 and $200.

Full-time training courses are available in a number of establishments including the Central Technical High School (Toronto), Gander District Vocational School (Newfoundland), Southern Alberta Institute of Technology (Calgary), the Institut aerotechnique au Quebec (Montreal) and the Vancouver Vocational Institute (B.C.). Courses are of two or three years duration and are primarily designed to meet the licencing requirements for engineers; some of the time may be allowed against the practical experience requirements for licencing.

Advancement: Opportunities include positions as foreman of a specialist section and in the Quality Control (Inspection) Department. By pursuing further courses of study, it is possible to qualify as a licenced engineer; this opens up an alternative line of promotion.

Future Outlook: Employment opportunities for qualified personnel over the next few years are expected to show some increases but openings for learners are probably limited for some time to come.

Aircraft Maintenance Engineers

Nature of Work: Maintenance engineers are engaged in duties which are similar in many respects to those of mechanics described in preceding paragraphs; they are concerned with the functions of servicing, repair, dismantling, overhaul and reassembly of airframes, installed systems and equipment and the power plant which make up an aircraft. Any or all of these tasks may be done by engineers; however, in all but the smallest companies, it is the usual practice for engineers to supervise a group of general and specialist mechanics and to concentrate on fault diagnosis, inspection and testing various systems for correct functioning. A brief outline of the engineer's supervisory and similar duties is given in the following paragraphs; this should be read in conjunction with the duties given under the heading "Aircraft Mechanics".

Engineers must qualify by examination for licences issued under international regulations administered in Canada by the federal Department of Transport. Licences are issued in several categories and the engineer may hold any or all of these licences.

Engineers licenced in Category "A" inspect fixed wing aircraft, including the airframe, engines and installed equipment, and certify that the aircraft is airworthy—fit for flight. They ensure that the "before-flight" servicing detailed in the Servicing Schedule has been carried out; that any defects in the coverings of the airframe have been repaired; that units or items removed for servicing have been correctly reinstalled; and that all services—flying controls, deicing, hydraulic, pneumatic, instrumentation, electrical, etc.—function correctly. In addition, an engineer with an "A" licence may partly dismantle an engine and associated accessories; a knowledge of engine testing, repair and overhaul procedures is therefore required.

Engineers licenced in Category "R" are employed in similar duties to those licenced in Category "A" except that they work on rotary wing (helicopters) only.

Engineers licenced in Category "B" inspect airframes only after major overhaul, when the airframe has been modified, or the role

of the aircraft changed, and certify that the airframe is airworthy; it should be noted that this engineer does not work on engines. A knowledge of airframe construction methods is required, particularly methods of testing major components after installation. For example, the engineer measures wing-to-fuselage angles (dihedral and incidence) and must apply construction procedures to rectify inaccuracies; measures the rigging (angular and linear movement) of the flying controls—elevators, ailerons, rudders, trim tabs—and tests various systems, such as the hydraulically operated flaps or landing gear, under normal and emergency conditions. In addition, the engineer takes part in test flights to "swing" the compass (makes a correction card indicating inaccuracies), checks the operation of the electrical system in flight and other features such as the functioning of the instruments.

Engineers in Category "D" are responsible for all work done on the engines after major overhaul and certify that the engine is fit for flight. Included in the duties of this engineer are testing, inspecting and adjustment of the induction, carburetion, ignition and cooling systems of the engine and associated mechanical and electrical units.

Working Conditions: In general, conditions are similar to those of mechanics, and the engineer leads an active and varied life. Engineers with an "A" or an "R" licence usually spend part of the day outdoors running up engines and attending to supervisory duties, and the remainder indoors where they inspect work in progress. Those with "B" or "D" licences are more likely to be indoors where, in the larger repair and overhaul depots, they alternate between inspection work in the repair shops and the quality control or engineering offices.

Preparation and Training: The generally recommended route to qualify as an aircraft maintenance engineer is to take full-time courses at one of the establishments given on page 72; these courses are keyed to high school graduation. Subjects include aerodynamics, theory of flight, drafting, physics, mathematics and chemistry. Related practical tuition includes engine and airframe overhaul procedures, machine-shop practices, sheet-metal work and welding.

However, many engineers have acquired their practical experience by working as mechanics and, through part-time study, have learned the required academic subjects. Licencing examinations are given at main centres by the Department of Transport and include written, oral and practical tests. For complete details of examination requirements the reader is referred to the publication ENGINEERING INSPECTION MANUAL, which is available through public libraries or can be purchased, price $2.00 per copy, from the government bookshops listed on page 2 of this booklet.

To take the examinations for a licence, candidates must be over 21 years of age and have the following employment record:

Category "A"—three years practical experience on maintenance of fixed wing aircraft—airframe and power plant

Category "B"—five years experience on airframe construction, overhaul and maintenance

Category "D"—five years experience on engine construction, overhaul and maintenance

Category "R"—three years experience in maintenance of rotary wing aircraft (including power plant and accessories).

From the foregoing, time may be deducted for completion of courses at approved schools. Licences are renewable at three-year intervals without examination if the licence holder has been regularly performing engineering duties.

Personal Qualities: As head of a team, the engineer requires the ability to get along with others, to make firm decisions, and to be stable under adverse and trying conditions. A keen sense of responsibility is demanded as is accuracy in the smallest detail since carelessness could have serious consequences both to passengers and to the aircraft.

Advancement: Promotional opportunities depend on obtaining the required licences and seniority, particularly in large airlines.

Positions as supervisor, head of inspection services, production manager and chief maintenance engineer are available; in the latter position, the engineer may be in charge of the entire maintenance program of a small company.

Future Outlook: Opportunities are reasonably good since a steady expansion of airline services is expected in the years ahead. It should be noted however that the total number of openings is relatively small. Department of Transport figures show that there were 2,309 licenced engineers in 1964; this figure was 1,544 in 1955 indicating an average increase of approximately 80 engineers per year.

TRADE AND BUSINESS OCCUPATIONS

Department stores, fuel supply companies, office equipment suppliers, sporting goods dealers, large hardware stores and many other sales outlets employ a group of workers in mechanical repair occupations to provide their customers with "after-sales" installation, servicing and emergency repair facilities. This work is done either in the customer's home, in a department of the retail store, in service centres operated by distributors and manufacturers in main population areas, or in independent shops whose sole business is that of repair.

Employment opportunities will be found in all parts of the country but the greatest concentration is in large metropolitan centres where there will be several hundred servicing occupations; however, even in the smallest towns there are some employment opportunities. It is estimated that 15,000 workers are employed in the servicing of appliances and equipment used in homes and businesses.

Although servicemen are employed on different kinds of equipment, their work is similar in that all require analytical ability based on an understanding of mechanics and general fitting practices, related sciences (hydraulics, pneumatics, elementary metallurgy, electricity and perhaps electronics), theory of the trade (refrigeration, combustion principles, etc.) and mathematics (arithmetic

process, lineal measurement, volumes, areas, percentages, elementary algebra). A knowledge of basic electricity, particularly the ability to solve equations from circuit diagrams, and of local and provincial regulations and the Canadian Electric Code is of increasing importance since most equipment now incorporates motors, controls and other electrical components.

Except where otherwise indicated when specific occupations are described, entry is by obtaining employment as a helper or learner and acquiring skills by working on the job under the guidance of experienced servicemen. In several provinces, courses are being added to the curricula of trade or vocational schools and formal training programs are being set up. Information concerning courses in a particular province can be obtained from the provincial Department of Labour, the Department of Education (through the school guidance counsellors) or the local office of the National Employment Service.

In all repair work, skills with the hands and with handtools are important but form only part of the qualifications needed for success. Servicemen must be neat and clean both in appearance and working habits and must be able to retain the confidence of the customer in the product and in the serviceman's employer; new entrants are usually selected with this in mind.

Mechanically inclined young men who, for various reasons, do not graduate from high school can find a growing number of employment opportunities during the next decade in the servicing and repair work offered by sales outlets. It must be pointed out however that those who do not complete their formal education will be at a disadvantage in obtaining employment or, later, in servicing the new and increasingly complex equipment now entering the market; their opportunities for advancement may also be limited. Employers normally give preference to high school graduates.

In a number of the occupations included in the following paragraphs, there are opportunities to become "self-employed", i.e., it is possible to open one's own business for those with sufficient capital for parts, tools, and to tide them over until they have established a clientele.

Appliance Servicemen

Between "perking" the breakfast coffee and going to bed under electrically heated blankets, the modern homemaker uses a dozen or more household appliances to polish the floor, cook the food, do the laundry, open tins, sharpen knives and carve the roast. Servicing and repairing these appliances, either in the home, back at the store or in independent repair shops is the work of *appliance servicemen.*

Although servicemen usually specialize in one "brand" or in certain groups such as "major" appliances (washing machines, refrigerators, cooking ranges) or "small" appliances (toasters, hair dryers, kettles), their work is similar in that all are concerned with investigating customer complaints and providing remedial services. It should be noted that independent shops offer service or repair facilities for a wide variety and many brands of appliances.

Nature of Work: With a defective appliance, the first step is to obtain a report from the customer—usually the housewife. Obvious faults such as inadequate electrical or gas power supplies, blown fuses or frayed electrical cords, obstructions (lint accumulations in the washing machine or a blocked gas jet in the cooking range), perished hoses and other visible defects are rectified. If the appliance can be started faults will be evident to an experienced serviceman from grinding sounds (gearing faulty), loud humming (possibly a faulty motor) or other abnormal noises. The serviceman will also know from experience which parts are more likely to fail than others and these are replaced, in turn, until the defective part is isolated; that is called "repair by substitution" and forms an important part of the serviceman's skills.

If visual checks and part substitution are insufficient, it may be necessary to dismantle the appliance so that gearing, pumps, transmissions and other mechanical parts can be examined for defects and rectified; this calls for skills in the use of pliers, wrenches and screwdrivers or the special handtools supplied by the manufacturer. Additional checks may be required such as the following: electrical circuits tested for continuity with voltmeters, test lamps and special

devices such as an "amprobe" in conjunction with the manufacturers' circuit diagrams; tests with chemical test kits to determine fuel efficiency; and checking such features as temperatures, dial and indicator setting and timing cycles with master timers and thermometers.

As indicated in the preceding paragraphs, most of the repair work in customers' homes is by substituting replacement parts for those which are suspect. Items which have been removed are returned to the store for repair on the bench or, as is more likely, forwarded to the distributor or manufacturer for overhaul; this provides a field of work for bench servicemen who usually specialize in one job such as electrical motor repair.

Major appliance servicemen work primarily in customers' homes, independently of direct supervision, and install or repair laundry equipment, cooking stoves, refrigerators and other appliances which are too large to return to the store. There is some tendency towards specialization; for example, servicemen employed by utility companies may specialize in gas-operated equipment since, in most provinces, this work must be done by licenced personnel (page 53).

In general, installation consists of assembling those units which were dismantled by the manufacturer for ease of transport. Connections have to be made to electrical power sources or to gas lines and such work as ducting installation or piping attachments to water or waste outlets are required; this requires a knowledge of plumbing, gas fitting or electrical regulations. After installation, the appliance is checked for correct functioning and frequently the user is advised on such features as the load capacity of a washing machine or the purpose of various control settings.

Repair of major appliances requires skills in the use of a wide range of handtools, small power tools such as drills and grinders, soldering and brazing equipment and the testing devices previously mentioned. These tools together with an extensive stock of replacement parts are carried on the serviceman's vehicle which, in effect, is a travelling workshop. Considerable variety is offered: the serviceman, or his helper, drives a light truck or automobile throughout the assigned district; keeps records of parts used and hours worked;

estimates costs and may collect charges; and may be engaged in the sales or promotion of new equipment. This requires a knowledge of small business practices, bookkeeping and provincial or municipal regulations.

Small appliance servicemen are employed under close supervision in repair shops or the repair section of a retail store and, in contrast with major appliance servicemen, rarely come into contact with the customer. They dismantle, repair and overhaul "traffic" appliances including frying pans, food mixers, toasters, percolators and similar kitchen equipment on the bench. Depending on the nature of their employer's business, the appliance serviceman either repairs a wide range of equipment or may specialize in one or several of the following: household appliances; lawn-mowers; small power tools; vacuum cleaners; or sewing machines.

Repair procedures used by small appliance servicemen are similar to those used by major appliance servicemen; however, small appliances usually have simpler controls and fewer working parts. Again skills with handtools are important and the serviceman must be quick to recognize defects and make the necessary repairs otherwise labour charges could exceed the price of a new kitchen appliance.

Preparation and Training: Entry into either small appliance or major appliance servicing is by obtaining employment as a helper or learner and acquiring skills under the direction of experienced workers.

On entering employment, learners are assigned for the first six months or so to relatively simple tasks and progress to repairing several varieties of appliance. In addition to learning on the job, ambitious workers take part-time courses in trade schools, or through correspondence, and study the manufacturers' servicing and instruction manuals. Classroom courses are also provided by local distributors or manufacturers particularly when new appliance models are placed on the market.

The length of time required to become fully efficient depends on the ability of the learner, however, two or three years are considered necessary before a major appliance serviceman is assigned to a district; small appliance servicemen require about a year.

Working Conditions: Major appliance servicemen enter many different kinds of homes and, at times, repairs may be done in somewhat confined surroundings. There are few occupational hazards other than those associated with driving a vehicle and minor burns or bruises from handling heavy equipment. In the repair shops, conditions are considered good, with adequate lighting and other conveniences, and the work is not strenuous. An 8-hour day, 5-day week is normal although servicemen in sales outlets may be required to work while the store is open on week-ends and on late closing nights; calls may also be expected outside these hours to make emergency repairs to, say, a cooking stove or refrigerator.

Advancement: Opportunities include positions as foreman in the larger repair shops and customer service manager in a sales outlet; appliance salesman is another possibility. There is also the opportunity to open one's own business.

Future Outlook: Employment opportunities are expected to increase over the next decade in addition to the need to replace those who retire or move to other work. This forecast is based on anticipated increases in the number and complexity of new appliances and equipment entering the market. Stimulation of demands from a predicted above-average increase in the number of young people who will set up homes during the latter part of the 1960's is also anticipated.

Heating System (Domestic) Servicemen

Introduction of the fully automatic oil burner during the 1920's, which grew out of an invention originally designed for the automobile, marked the end of the drudgery associated with wood and coal-burning stoves. Today, the householder has the choice of several systems—fuel oil, natural gas or electricity—all of which require only the physical effort of setting a thermostat.

The type of system to be installed in a home is decided before construction is started since provision has to be made for such structural features as oil tank location, ducting, piping layouts, insulation requirements and electrical wiring. This is the work of heating-

Photo: SHELL OIL LIMITED

The serviceman tests an oil-burning furnace for combustion efficiency to economize on fuel

system mechanics in conjunction with architectural and engineering designers, plumbers, pipefitters, sheet-metal workers, electricians and the other craftsmen described in CAREERS IN CONSTRUCTION in this series (*see* inside front cover).

Early oil-burning stoves were large and cumbersome by present-day standards but, with improvements in design and the national prosperity of the 1940's, they rapidly began to displace the coal stove. This displacement continued and, at the present time, over 50 per cent of the homes across the country are equipped with oil-heating installations.

Gas as a source of heat also fell into disuse and a decade ago supplied only 3 per cent of the nation's total energy requirements. With the discovery of vast natural gas deposits in Western Canada and the laying of transcontinental pipelines to major population centres, this figure grew to 15 per cent by 1964 and is still climbing. Of this energy, one-third is now used to heat 30 per cent of the homes across the country and also provides hot water, laundry facilities, cooking, incineration and other domestic uses.

Use of electricity for home heating is a comparatively recent change in space heating concepts but at the end of 1963 there were 7,600 "all-electric" homes (mainly in Ontario) either built or under construction; this figure reached 12,600 by the end of 1964 with building mainly concentrated in all-electric subdivisions.

As with all mechanical installations, domestic heating systems must be serviced to reduce the possibility of breakdowns and to keep fuel costs as low as possible. This is the work of the servicemen described in the following paragraphs who specialize in either fuel-oil or gas-fired installations and who also provide repair services in an emergency. It should be noted that electrical heating systems are maintained by those trained in electricity rather than in mechanics; full details of careers in electricity are given in ELECTRICAL AND ELECTRONIC OCCUPATIONS in this series (*see* inside front cover).

Oil-Burner Servicemen

Fuel-oil suppliers, who provide their customers with free or low-cost servicing contracts, offer the main field of employment for *oil-burner servicemen.* Other servicemen are employed in independent shops where they work under contract to the fuel-oil suppliers or build up their own group of customers.

Nature of Work: Starting about the end of May and continuing throughout the summer months, oil-burner servicemen travel to customers' homes using a truck which is equipped with a full range of tools, testing equipment and spare parts. In the home the serviceman cleans, lubricates and adjusts the heating system components and replaces those which are defective.

Major assemblies such as the oil burner are dismantled for servicing; fuel filters and air screens are either cleaned or replaced; motors are lubricated and together with other electrical components are tested for continuity or resistance; igniters are examined and their spark gap adjusted; fuel nozzles are cleaned, adjusted or replaced; and air pattern controls, fans, couplings and other moving parts are cleaned, lubricated or adjusted as necessary.

Other assemblies including the flue pipes, chimney base, and the heat exchanger are cleaned; pumps are purged of air and leaking gaskets replaced; and auxiliary units such as humidifiers receive attention.

To ensure that the system is functioning correctly, tests are then made with equipment such as flue gas temperature thermometers, draft gauges, carbon dioxide analyzers and smoke analyzers.

Preparation and Training: Entry into oil-burner servicing occupations has been to obtain employment with a fuel-oil supply company or with an independent repair shop and to learn the occupation under the guidance of experienced servicemen. However, there are now an increasing number of preparatory courses available in trade and vocational schools and these improve the possibility of obtaining employment. The average learning period is about two

years for those who have taken pre-employment courses. In several provinces, oil-burner servicemen (and also those concerned with new installations) are required to obtain a provincial licence renewable annually. This usually includes a test based on an adequate knowledge of CSA Standard B1-39 (Installation Code for Oil-Burning Equipment) together with proof of suitable practical experience.

Personal Qualities: All servicemen must be clean, have a pleasant manner and similar qualities to help retain the confidence of the customer in the employer's service and product. This is a time-demanding occupation which may appeal to those who prefer to work with the minimum of supervision, enjoy meeting people and who like to move around.

Working Conditions: The oil-heating installation is normally located in basements which may be poorly lighted and cramped for space. As previously stated, during the summer months the serviceman has an assigned district to cover and to a large extent can keep regular working hours. In winter, however, there are rotating shifts and, at busy times, the serviceman may be on "standby", i.e., expected to take emergency calls at hours outside the working shift. As with most mechanical repair occupations, oil-burner servicemen are required to purchase a kit of handtools and some measuring devices; the cost ranges between $100 and $200.

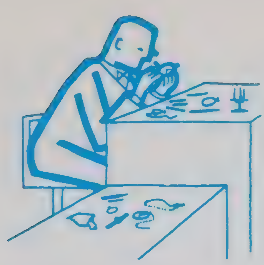
Advancement: Prospects for advancement to service supervisor are good for those with above-average skills and who have the necessary personal qualities. A number of oil-burner servicemen have opened their own repair business with little more than the kit of tools they purchased while working for an employer.

Future Outlook: For the future the prospects of continuing employment are good. In addition, there are indications of considerable activity in the construction industry and this, in turn, is expected to increase the number of oil-heating installations. The competing systems of gas and electricity are not expected to have a marked effect on overall employment opportunities. Based on the foregoing, it is expected that during the next decade employment opportunities will increase.

Gas Servicemen

Gas servicemen who are known by other titles such as home-heating care servicemen or domestic gas fitters, are part of a group of skilled mechanics who not only service domestic installations but also install, repair and maintain gas systems in factories, business establishments and other large buildings. These servicemen are employed by large utility companies and home-heating contractors who provide householders with emergency repair facilities and may offer individual servicing contracts.

Nature of Work: On receiving an emergency call, the gas serviceman drives to the location in a truck equipped with testing equipment and spare parts. Such features as the pilot light may be examined, pipelines may be tested for leaks and the electrical controls, fans and other auxiliary units cleaned, adjusted and repaired in a similar manner to those employed by oil-heating system servicemen. With gas-fired installations, emphasis is placed on safety and servicing or maintenance can only be done by those who are licenced under provincial regulations. Details of licencing requirements and further information are given on page 53.



Watch and Jewellery Repairmen

Credit for the origin of the modern timepiece is given to Thomas Tompion, an English blacksmith, who during the 17th century invented a "dead-beat" escapement—the mechanism which controls the backward and forward movement of the flywheel. Two further improvements made possible the precision watch of today: the cylinder escapement invented in 1720 by George Graham and the lever escapement invented by Thomas Mudge in 1746.

Continued developments have taken place both in accuracy and in design so that the present-day timepiece is a highly complex mechanism which is vital in business operations, aircraft and ship navigation, scientific experiments, flights in outer space and such commonplace events as football games and television programming.

As with all mechanisms, timepieces must be lubricated and require periodic overhaul or "conditioning". This is the work of "watchmakers" or watch repairmen who, in addition, may undertake engraving and simple jewellery repairs. In the following paragraphs the descriptive term "watch repairmen" has been selected although the old title of "watchmaker" is still used. The latter title dates from the time when watches were made by hand and returned to the same craftsman for repair. With the advent of watchmaking factories and assembly line methods, the two duties have become separated and the following description is of craftsmen engaged in repair work only.

Watch Repairmen

Watch repairmen are employed by department stores, watch and jewellers' stores and other retail outlets, wholesalers' "trade shops" (they normally provide services to retail stores only) and separate repair shops, a high proportion of which are owner-operated.

Nature of Work: Typical of the duties in a repair shop are cleaning, lubrication and the adjustment or replacement of defective watch parts: this is precise delicate work demanding a high degree

of manual dexterity and should appeal to those who are painstaking and pay great attention to detail. In sales outlets, the duties of the repairman will also include cost estimation and possibly the promotion and sales of new items.

Cleaning usually consists of unscrewing or prying off the back of the watch, removing the mechanism from the case, removing dirt and oily deposits either with a brush dipped in solvent or by immersing the complete mechanism in a solvent bath. Lubricating is done by applying droplets of oil on the contact points.

Conditioning will involve dismantling the mechanism into springs, balances and other subassemblies with the aid of tweezers, pliers, screwdrivers and similar extremely small handtools. The parts are then examined through a magnifying lens since with such finely balanced assemblies, the slightest wear affects the alignment and accuracy.

Many other parts may require attention: the escapement is subject to wear and the balance staff to damage by hard knocks; the main spring may be overwound with consequent damage to the associated cogs and pinions; or the winding mechanism may become defective. The parts are then cleaned and lubricated and the watch movement rebuilt. In addition, the watch repairman encounters timepieces with electrically operated mechanisms, with transistorized controls or having such auxiliary units as alarms and chimes. Engraving and jewellery repairs such as inscribing the owner's name, repairing broken links, or remounting the mechanism in a brooch or bracelet may be required.

It is the normal practice to replace defective parts with new items from stock. Adjustments may be required such as "trueing" a new shaft on a lathe to ensure an accurate fit but with the development of interchangeable parts, the need to make new items has considerably reduced. However, there are times when new parts may not be available—older watches or special time-pieces for example—and these have to be made by hand. For this work, the repairman requires a knowledge of design drafting (based on the theory of watchmaking), material selection, treatment of metals (hardening, tempering and

Photo: BIRKS LIMITED

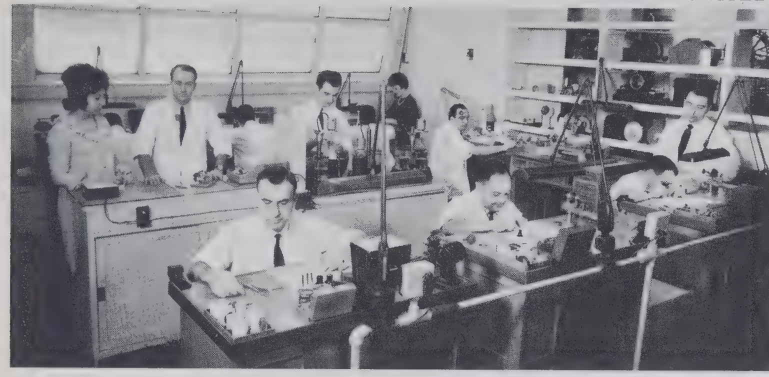


Photo: N.F.B. 17581

Photo: N.F.B. 52536

Photo: N.F.B. 52537

Watch repair (top and centre left) and jewellery fashioning (bottom and centre right) are highly skilled crafts

polishing) together with skills in such operations as hand shaping with files, drilling or turning on a watchmaker's lathe.

Preparation and Training: Entry into watch repairing occupations may be by one of several methods. In the provinces of British Columbia and Ontario, there are formal apprenticeship training programs (page 110). Another method is by working as a learner or helper and acquiring skills through initiative and ability under the guidance of experienced repairmen. With both the foregoing methods, it is necessary to obtain employment and there are indications that such openings are limited. The route now generally recommended is to take courses such as are offered in the following schools:

MANITOBA TECHNICAL INSTITUTE, Winnipeg, Man.
One-year course after Grade 11
minimum age not specified
Jewellery courses also available

* * *

PROVINCIAL INSTITUTE OF TRADES, Toronto, Ont.
20-month course after Grade 10
minimum age 18
Jewellery courses also available

ECOLE DES METIERS
Trois Rivieres, P.Q.
One-year course after Grade 10
minimum age 18
Jewellery making also included in watch repairing course

* * *

SCHOOL OF COMMERCIAL TRADE, Montreal, P.Q.
Two-year course after Grade 10
Jewellery making, including work with semi-precious and precious stones is also included in the watch repair course.

The course content in the schools comprises training in the theory and practice of watch repair and also includes additional subjects such as elementary metallurgy (heat treatment of metals), physics, chemistry and business practices. A considerable amount of time is occupied in dismantling and reassembling watch movements, selecting and fitting jewels, removing and replacing balance staffs and wheels, adjusting hairsprings, matching escapements, and fitting or adjusting stems, sleeves, crowns and bows. Emphasis is placed on rapid diagnosis of faults and acquiring skills in the use of handtools.

As with most mechanical repair occupations, the watch repairman is required to purchase a set of handtools which costs between $200 and $300. Further equipment is often purchased and it is not unusual for the self-employed watch repairman to have $1,000 or more invested in hand and machine tools, watch timing machines and other equipment.

Personal Qualities: Essential to the craft of watch repair are steady hands and a keen sense of touch plus the ability to concentrate for long periods of time on minute work. General health and eye sight (either normal or corrected) must be good but there are no specific physical requirements other than those given to all new employees on taking up employment. Limited movement of the lower limbs is not considered a handicap provided that it is possible to sit at a bench for about 90 per cent of the workday. A definite inclination towards fine model work and the ability to pay great attention to detail are indications of suitability for watch repairing.

Working Conditions: Although the work area in a store is generally small it is well lighted, clean and adequately ventilated. Eyestrain from close observation of workpieces is a possibility. Repairmen in trade and other repair shops usually work an 8-hour day which may include Saturdays. In department stores and jewellery shops, the repairmen are required to work one or more evenings per week where "late closing" is permitted; there is a trend however towards a shorter week. In the province of Quebec, for example, a 44-hour week has been established by provincial statute; similar legislation is in force in Ontario and is being introduced in other provinces.

Earnings of repairmen vary: some are paid a fixed hourly rate; others have a minimum salary or receive a percentage of each watch repairing labour charge, whichever is the greater; others are on a percentage basis only. Additional income may be received in the form of commissions on volume of sales. However, earnings are such as to provide a better-than-average standard of living. Apprentices, as is the normal practice when learning a craft, are paid a percentage of the skilled man's rate. For example, the range would be from 75c per hour in the first year and rising by annual increments to $1.40 in the final year (Quebec rates).

Advancement: Opportunities include those of chargeman or foreman in the larger repair shops; some jewellery store owners require their managers to be experienced watch repairmen; opening one's own store is another possibility. At the present time, the watch repairmen's skills are in demand to make or repair precision measuring or other equipment used in scientific and technical fields; this is highly paid work.

Future Outlook: Employment opportunities over the next decade are expected to show some slight increases over the need to replace those who retire. This is based on an anticipated population growth, increases in the number and complexity of watches being worn together with movement of repairmen into scientific and technical fields.

Jewellery Repairmen

Retail stores normally provide a "customer repair service" which provides a field of work for *jewellery repairmen*. Their duties are often combined with selling jewellery, china, glassware and similar merchandise. Customer service includes: "sizing" rings that is, they are cut with saws, pieces are added or removed and the joints welded with gas torches; pins and fasteners are soldered into position; stones are reset in their claw or other mountings with adhesives; clips and links are replaced using small pliers and screwdrivers; and jewellery is cleaned or blemishes removed with scrapers, polishers, buffing wheels or with chemicals.

For the more complicated types of repair, it is the usual practice to send jewellery to "trade shops" operated by wholesalers and which are concentrated in Toronto and Montreal although a few of these shops are located in major population centres across the country.

Nature of Work: Typical of the many duties of jewellers in trade shops are the following: special pieces may be made or remodelling done almost entirely by hand which necessitates a complete knowledge of design and of all aspects of jewellery making—casting metal, shaping by hand, stone setting, polishing and engraving; old-fashioned jewellery may be modernized either from the jeweller's own designs or from those supplied by a specialist designer; replacement parts may be formed by hand or, where ready-made blanks are supplied, the excess metal has to be cut away and such shapes as claws in which jewels are mounted may have to be formed; joints are soldered and adornments added; stones may be mounted in prongs with adhesives; and the item engraved and polished to the desired finish and beauty.

The skills of highly trained jewellers are also used in jewellery factories where production is by assembly-line methods. Here the jeweller often specializes in a particular function such as creating initial designs or the reproduction of pencilled sketches in wax and executing samples in metal. Later tools and dies will be made from the samples by toolmakers* and the jewellery manufactured by production workers such as press operators, metal casters, stone setters, polishers, painters and enamellers.

Engraving such as cutting monograms on rings and inscriptions or decorative patterns on silverware is also the work of jewellers although where the volume of work is large, this is done from prepared designs by a specialist engraver. Chisel-like "gravers" which the jeweller may design and make from steel are the main handtools; mechanical aids such as the pantograph—used to trace and enlarge patterns—are also available.

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*Tool and die makers are described in METAL WORKING OCCUPATIONS in this series (see inside front cover).

Preparation and Training: Entry into jewellery occupations may be through apprenticeship training—the provinces of Ontario and British Columbia have a formal apprenticeship program (page 110)—or by obtaining employment as a learner. These openings are extremely limited and are often filled by those recommended by relatives or friends already working in the trade. An alternative method is to obtain training such as is offered by the schools listed on page 90; full information on entry requirements, course content and fees can be obtained by writing to the school Registrar. The courses are of two years' duration and cover such subjects as design, model making, gemstone setting, repair work, metallurgy and finishing treatments, and gemology (the science of gemstones) together with general educational subjects.

Personal Qualities: A high degree of manual dexterity is required plus the ability to concentrate for long periods on close work. In these and other respects the personal qualities are similar to those of watch repairmen. There are no specified physical requirements although good eyesight (either normal or corrected with glasses) is necessary. An artistic sense is of particular value to those interested in design work and is a requirement in all jewellery occupations. Working conditions in retail outlets and trade shops are similar to those encountered by watch repairmen.

Advancement: Opportunities include head of a department in the trade shops or manager of a retail store; opening one's own business is another possibility.

Future Outlook: Over the next decade employment opportunities for highly qualified jewellers are expected to be good but new entrants, or those with only average ability, will experience difficulty in finding suitable employment. Openings which arise from the need to replace those who retire or transfer to other fields of work are few since the numbers employed in the occupation are relatively small and jewellers often work beyond what is considered the usual retirement age.

Business Machine Repairmen

Although no one may have noticed at the time, except perhaps the clerks who must have wearied from their tedious job of writing letters and making calculations by hand, the introduction into offices of mechanical "type writers" and the calculator was the start of mechanization of clerical work.

Since the Industrial Revolution, the amount of "paper work" to control the many new clerical functions required by commerce and industry had steadily grown and demands were made for faster and more efficient ways of processing this material. To meet these demands, inventors became active, the crude type-writer which had been invented during the 18th century was refined and improved and mechanical equipment for accounting, calculating, duplicating and many other functions made an appearance.

The substitution of mechanical equipment for the clerical tasks formerly performed by hand, stimulated the growth of a group of occupations—*business machine servicemen* (often called "service representatives"). They are responsible for keeping the equipment in good order and operating at maximum efficiency. With the advent of machines operated electrically and perhaps electronically, and the combination of several machines into a single multi-purpose machine, there have been further marked changes. Personnel are now usually trained to service a wide range of machines rather than a single machine such as a manual typewriter. Additionally, a knowledge of sciences such as electricity is increasingly necessary.

Business machine servicemen are employed in the branch offices or service departments of equipment manufacturers and in independent shops both of which may combine repair work with the sale of new equipment. These establishments tend to be concentrated in large population centres which are the main headquarters of large business concerns and government branches; however, even relatively small communities have a local agency where business machines are repaired.

Nature of Work: Business machine servicemen clean, lubricate and overhaul equipment and, as necessary, dismantle and examine the component parts. In the manufacturers' shops, servicemen are concerned with the manufacturers' products only: in consequence, they are company-trained workers. Independent shops, or shops where the volume of work is low, service several different makes and types of machines but usually of the simpler variety. Basically, however, all servicemen require skills in the use of handtools such as screwdrivers, pliers, drills, wrenches, soldering irons (to repair electrical connections) and files together with micrometers, gauges, voltmeters and similar testing equipment.

It is the normal practice for "Maintenance Agreements" to be made between the customer and the equipment supplier; other machines are supplied on a rental basis. In both instances, the serviceman visits the customer's premises at fixed intervals to ensure that the mechanical or electrical and electronic systems are operating correctly.

Servicemen are also "on call" to make emergency repairs. These repairs, and major overhauls, usually involve dismantling the machine so that pinions, gears, drives, rollers and other components can be examined for defects or measured for excessive wear. This requires the ability to read and interpret mechanical and electrical diagrams.

As previously mentioned, servicemen are usually trained to repair different kinds of machines. Depending on the policy of the employer however, some servicemen in the larger depots, may concentrate on one "line" of machines such as the typewriter group. Selected from the many lines of machines which the serviceman may repair are the following:

Typewriters are used not only in commercial and business establishments but also in hospitals, schools and individual homes. In consequence, servicemen meet a variety of working conditions. In addition to the manual typewriter, an increasing number of this line of machines are fitted with electrical controls or with auxiliary units such as perforating and duplicating attachments. It is therefore increasingly important for the serviceman to have a knowledge of electricity in addition to mechanical ability.

Bookkeeping and accounting machines perform a variety of functions and can be considered as a combination typewriter and adding machine. This equipment is used in large stores, banks and other financial institutions and may be built or adapted to suit the customer. The serviceman may be required to make changes, in addition to routine or emergency servicing, and afterwards instruct the customer on the correct methods of use.

Dictating machines are used to record discussions, correspondence and other spoken information prior to being transcribed by a typist. This equipment, of which the tape recorder is an example, is normally maintained by personnel skilled in radio repair work, can read and interpret electrical diagrams and have a working knowledge of electronics.

Duplicating machines produce copies of printed, typed and written material. Some of this equipment is simple and requires little maintenance. There is a trend however towards the installation of extensive duplicating facilities, particularly in large establishments. This equipment includes machines to make reproducible plates (these may operate on electro-static principles), offset duplicators and auxiliaries for punching, collating and binding. Most of this equipment incorporates electrical or electro-mechanical and perhaps pneumatic or hydraulic controls.

In addition, the machines used for accounting, cash registry, mail handling and time recording also require maintenance by business machine servicemen.

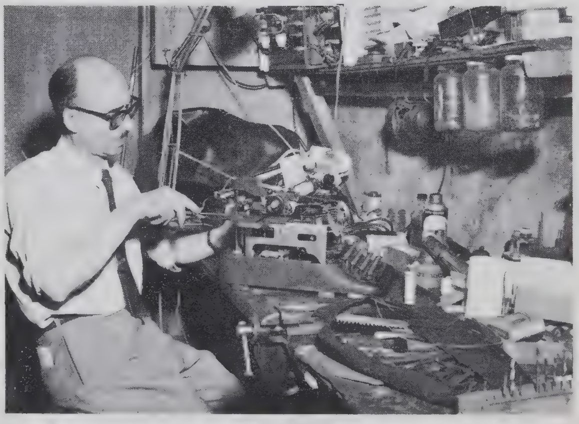
Preparation and Training: Most employers, and particularly those with planned training programs, consider high school graduation (or equivalent) as the necessary entry requirement. Preparation for entry into the occupation can be obtained through the increasing number of courses, such as typewriter or duplicating machine servicing, being added to the curricula of vocational and trade schools. For related occupations such as the servicing of computers or business machines used for electronic data processing, courses of training outlined in TECHNICIANS IN SCIENCE AND ENGINEERING (in this series) could be considered.

Photo: MILES OVEREND

Photo: N.F.B.

Repairing office machines presents a variety of problems

Photo: CITIZENSHIP AND IMMIGRATION



Since training is given on the job it is first necessary to obtain employment with a business machine company or a repair depot as a learner or trainee. The length of training depends on the ability of the learner but about one year would be required to become proficient on the repair of manual typewriters. Three to four additional years on various types of machines would be required to become proficient on a manufacturer's full range of products. Further training, usually in the form of refresher or upgrading courses, is provided by the employer particularly when new or modified equipment is placed on the market.

Working Conditions: Repair shops are clean and well lighted and the work is not considered strenuous. A 5-day, 40-hour week is normal with limited overtime as the volume of work demands. Servicemen are also required to visit a variety of premises but most of these are "office-type" locations. There are few occupational hazards other than those associated with electricity.

Advancement: Opportunities for those with the ability to get along with people and proven merit include positions as foreman (in charge of seven to ten servicemen) and branch or agency manager. Other possibilities include those in sales, as an instructor, or in factory work such as production planning.

Vending Machine Servicemen

Within recent years there have been significant changes in the methods used to distribute consumer goods and services. Of particular interest to those examining mechanical repair occupations has been the growth, both in variety and in numbers, of automatic vending machines.

To the bubble gum machine of yesteryear and the "try-your-weight" machine have been added others which vend a wide variety of soft drinks, "ready-to-eat" hot meals, coffee and similar beverages (flavoured to individual taste), ice, candy bars, fruit and other foodstuffs. Coin machines also vend insurance, parking space, tokens or photographs or provide laundry services (the "Laundromat") and dry-cleaning facilities. Others play music in restaurants or offer various forms of entertainment.

With the rapid growth of automatic vending, there has been a corresponding growth in two occupations—vending-machine routemen and vending-machine mechanics—who service and repair the complex mechanical and electrical assemblies of which a machine is comprised.

The main fields of employment are with coin-vending machine companies who operate concessions in factories, railway terminals, airports, large office buildings, hospitals, sports arenas and wherever large groups of people congregate; these locations tend to be concentrated in main population centres. Other employment opportunities are with companies and concessionaires who sell and service coin-operated equipment in Laundromats, dry-cleaning establishments, restaurants and similar locations which are situated in all areas, even in the smallest towns.

Vending-Machine Routemen

Nature of Work: Vending machines are stocked with food, drinks or ingredients, or other items by *vending-machine routemen*. This is primarily a sales and service function and the amount of mechanical work undertaken is limited to simple repairs. However, this occupation is briefly described since it can be considered an entry route (for those who demonstrate mechanical ability and are trustworthy) to the position of mechanical serviceman or mechanic.

Each morning, the routeman loads up a vehicle with the supplies for the day (or the loading may be done by material handlers) and drives the vehicle to an assigned district. At each location, the routeman cleans the machines, ensures that supplies already in the machines are in good condition and adds replacement stock as necessary. Visual checks are made of various working parts, the coin boxes are emptied and the change makers replenished. The routeman then tests the machine for correct functioning usually by inserting coins into a machine and making various selections: for example, with a coffee dispenser, controls are selected to give various combinations of ingredients such as with or without sugar, with or without cream and so on.

Minor mechanical or electrical defects found during these tests may be corrected by the routeman but it is the usual practice to report malfunctions to the concessionaire's repair department who then dispatches mechanics to the location.

Preparation and Training: Entry into the occupation of vending-machine routeman is by obtaining employment as a helper or learner and acquiring skills by working on the job. Training courses may be supplied by individual employers or by equipment manufacturers. There are no recognized age limits but a mature person is required. A clean appearance and the ability to get along with customers are most important factors in obtaining employment. This occupation should appeal to those who like variety in their work, enjoy travel around an assigned district and meeting people, and who can work with the minimum of supervision.

Vending-Machine Mechanics

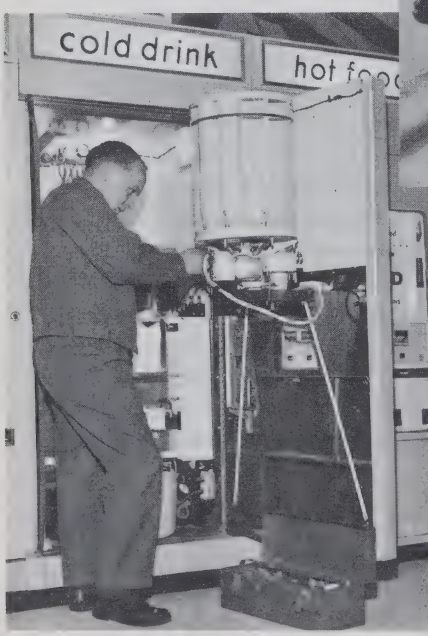
Nature of Work: Maintenance routines are undertaken by *vending-machine mechanics* in accordance with the equipment manufacturer's handbooks and, as previously mentioned, the mechanics are sent to locations where the defective machine is repaired.

At the location, the first task of the mechanic is to locate and isolate the trouble. Obvious defects such as damaged mechanisms, leaking water or refrigerant pipes and broken electrical connections are repaired. The finely balanced mechanisms may have been damaged with "slugs" (counterfeit coins), or machines requiring a level surface to operate correctly may have been forcibly moved. As far as possible defective parts are replaced with new items, pipes may be soldered or brazed and electrical connections secured. Should the foregoing repairs be insufficient, the machine is usually returned to the concessionaire's or manufacturer's repair department for dismantling and overhaul. Here, component parts are examined and tested for excessive wear, incorrect alignment, damage through misuse and other defects. Relays, thermostats and other electrical components are tested with ohmmeters, voltmeters and similar measuring devices in conjunction with electrical diagrams, and complex units including water pumps, electrical motors and other units may have to be dismantled or overhauled. Finally, the machine is reassembled and tested for correct functioning.

Above: the routeman regularly stocks vending machines

Centre: care of one's vehicle and safe driving habits are rewarded by bonuses

Below: skilled mechanics undertake major servicing and repairs



Photos: VERSAFOODS LIMITED

The vending-machine mechanic also undertakes routine procedures to keep breakdowns to a minimum. Mechanical parts are cleaned and lubricated and electrical components such as heaters, thermostats, and relays are removed at intervals for bench testing or overhaul to ensure that the machine will function satisfactorily until the next maintenance period.

This work requires a knowledge of mechanical principles, the ability to read and interpret mechanical and electrical drawings, and skills with wrenches, hammers, pliers, soldering and brazing equipment, and electrical testing devices. The shops are also equipped with power tools such as grinding wheels, drill presses and perhaps an engine lathe.

Preparation and Training: Entry is by obtaining employment as a helper or trainee and acquiring skills by working under the guidance of experienced mechanics for a period of about two or three years. Employers usually require new entrants to have demonstrated mechanical ability obtained through vocational school training or previous employment. Training courses are provided to their employees by concessionaires and equipment manufacturers. In several areas, courses of instruction for vending-machine mechanics are being added to the curriculum of trade or vocational schools.

Working Conditions: Routemen have an assigned district which has to be covered and the hours worked will depend on their diligence. Mechanics in repair shops have a fixed routine and about 44 hours per week is normal. There are few hazards provided that safety regulations applying to the use of electricity and power tools are strictly observed.

Advancement: Opportunities include those of senior mechanic or, in large companies, route or shop supervisor. Promotion to sales or advertising staff is another possibility.

Pin Setting Machine Mechanics

In large population centres, the bowling lanes are often equipped with automatic pin setters to do the work formerly performed by "pin boys". These are customer-operated machines which, depending on the control selected, pick up the pins in a scissors mechanism, sweep fallen pins (or "deadwood") and the bowling balls into return chutes and, through further mechanisms, position the pins and return the balls ready for the next bowler. The machines consist of a number of electro-mechanical assemblies which are maintained by a *pin setting machine mechanic* and several helpers or "chasers" who also rectify defects which occur while bowling is in progress.

Nature of Work: To keep breakdowns to a minimum, the mechanic is supplied with the manufacturer's maintenance schedule and other handbooks which detail servicing requirements at daily, weekly, quarterly and annual intervals. These routines include frequent cleaning or lubrication of moving parts, and visual or other checks of belts, springs, cables and similar components for signs of excessive wear and other defects. In addition, the motors, selector switches, relays, microswitches or other electrical components are cleaned, examined for wear and adjusted as necessary.

Defects and suggested remedies such as the adjustment of operating mechanisms, cable tensions, limit stops and electrical components are also given in the maintenance schedule. However, the mechanic will meet other stoppages and a thorough understanding of the principles of mechanical operation and of associated electrical systems is necessary to analyze defects and effect repairs. Defective components are usually removed and returned to the manufacturer for overhaul on the factory bench. The mechanic is also required to keep records of maintenance routines and to conduct correspondence with the manufacturer such as reporting frequently occurring defects and ordering replacement parts.

Preparation and Training: Training for mechanics is through courses of instruction provided by the manufacturer. Students in these courses must be sponsored by an intending employer and pass a mechanical aptitude test. There are no specified entry requirements but few are hired before the age of 20. Previous experience or training

through vocational schools in such subjects as mechanics, fitting practices including the use of handtools, and basic electricity are an advantage in obtaining employment.

Working Conditions: Bowling centres at times can be hot and noisy; hours of work are variable and the mechanic may be employed on rotating shifts during evenings, weekends and holidays.

Advancement: By moving to a larger bowling establishment where there may be several mechanics, openings occur as chief mechanic or supervisor; other possibilities include manager of a bowling centre.

Future Outlook: Employment opportunities are expected to increase moderately as more centres install automatic equipment. However, at the present time, this is a small field of employment when compared with other mechanical repair occupations and openings are few.

Related Occupations

There are several repair occupations in retail and similar outlets, in addition to those already described, where employment opportunities may be somewhat limited due to lack of training facilities, low numbers in the occupation, or for other reasons; however, to meet the many requests for information, brief details of selected occupations are given in the following paragraphs.

Gun-and-Sporting Equipment Repairmen

Gun-and-sporting equipment repairmen or "gunsmiths" are employed in sporting goods stores and similar retail outlets to provide repair and overhaul services to the 800,000 hunters who head for the open country in the Fall. However, except for a short period at the start of the season, the amount of repair work undertaken is limited and the repairman is primarily engaged in the sales of sporting goods and related equipment. Modern guns are guaranteed for a lifetime and should a defect arise it is the normal practice to return the gun to the manufacturer or the distributor; in addition, there is a fair amount of "do-it-yourself" repair work (although this is stated to be one of the major causes of accidents).

Older or foreign built guns for which replacement parts may not be readily available, or those which have been damaged by abuse, are returned to the retail or gunsmith's store for servicing and overhaul, usually a week or so before the opening of the season. Routine jobs may include fitting new sights, removing excessive metallic and powder deposits, adjustments and lubrication. Damage such as a broken part or a jammed cartridge case may be visible but for other major defects the gun has to be dismantled so that internal parts can be examined or gauged for excessive wear; replacement parts may then be made by hand or machined from metal stock and the gun reassembled and bench tested. Other jobs occur throughout the year such as "sporterizing" an ex-army rifle, barrel re-boring, chambering or cutting and fitting a new wooden stock.

At the present time, formal training schemes in gunsmithing are not available in Canada. Most of the approximately 30 gunsmiths practicing this craft have been trained through apprenticeship schemes abroad. During their apprenticeship, they were taught the principles of the craft by a master gunsmith and acquired skills in the use of wood-working and metal-working tools—chisels, sanders, scrapers, files and drills—and with measuring equipment such as micrometers, gauges and verniers. In addition, they learned how to operate lathes, milling machines, drill presses and boring machines, grinders and other tools of the machinist's trade, and the techniques of forging, welding, brazing and soldering.

This occupation could perhaps be learned by obtaining employment as a spare-time helper to a gunsmith, although there are indications that such opportunities are extremely limited, or by working in a retail store where repairs are carried out. Skills with handtools and machine shop practices could be learned in trade or vocational schools. It would also be necessary to study mathematics, chemistry, metallurgy (particularly heat treatments and the properties of metals—one popular gun is made of 22 varieties of steel) and, through textbooks and manufacturers' manuals, acquire the principles of gunsmithing.

Lock-and-Safe Repairmen

Lock-and-safe repairmen are employed in hardware and other retail stores, or in repair shops attached to the store; these establishments are located in most centres across the country. In the main population areas, there is enough business to keep several repairmen busy on a full-time basis; in smaller towns it may be necessary to combine repair work with the sales of locks and hardware to produce a reasonable income.

The work of the repairman consists primarily of opening locks for people who have mislaid their door or car keys. More specialized work includes opening safes in banks, opening or adjusting electrical and electronic burglar devices, and repairing locks damaged through force or perhaps containing a broken key. Installation of locks in buildings including the fitting of special safety devices and to glass doors or those with narrow stiles (uprights) is also undertaken.

Various methods are used to "pick" or open a lock, depending on the type fitted—they may range from the comparatively simple rim or mortise types to highly complex keyless combination devices. Some locks can be opened with master keys and other equipment together with manipulation and considerable "know-how", or experience, on the part of the locksmith; other may have to be drilled or dismantled with nose and core pullers, pin tweezers, probes and shims. Damaged locks may then be repaired and the locksmith cuts replacement keys with key-cutting and profiling machines, or with handtools, from a stock of blanks carried in the repair shop.

As will be realized, there are many different types of locks, each of which requires a considerable knowledge of the method of construction before opening or repair techniques can be devised. This can only be acquired through experience while working as a helper to an experienced locksmith; at the present time there are no formal training courses in Canada. A few vacancies occur from time to time in the larger cities; however, the learner must expect to spend a year or so on tedious work in the repair shop to obtain the rudiments of the trade.

Piano Tuners

Piano tuners or piano technicians are employed by music stores, piano repair shops and similar outlets to visit homes, schools, theatres and other establishments to service and maintain pianos. A significant number of the piano tuners are listed as self-employed.

Their main job is to adjust the strings of a piano so that they conform to established pitches and relationships. They also undertake minor repairs such as regulating the action, reshaping hammers, removing rust and vacuum cleaning the interior.

To tune a piano, the board covering the strings is removed and strips of felt are placed between the strings on either side of the note to be tested in order to mute them. The tuner then strikes the "A" note above middle "C" and compares the sound with that made on a tuning fork. By turning the string pin with a tuning hammer, the tension of the string is adjusted until the note is the same as that of the tuning fork. The remaining strings are then adjusted by comparing their tones with the "A" string already adjusted.

Formal training schemes in piano tuning techniques are not available in Canada at the present time owing to the small size of the industry. As necessary, however, piano manufacturers occasionally have courses of training either in their main plant or in their retail outlets. These courses would be of one and a half year's duration followed by several weeks in the repair shop. At least Grade 8 is required on entry. Some musical training such as a course of piano lessons would be helpful.

Certain personal qualities are important to the piano tuner in addition to mechanical ability, in particular, good hearing and tone discrimination; also necessary are a pleasant personality, patience and the ability to make a good impression on a client. This occupation involves considerable travelling and the piano tuner should have the use of an automobile. As with most mechanical repair occupations, the piano tuner must own a complete set of tools which may cost about $250. Those who are self-employed also purchase stocks of strings, hammers, pedals, felt, pins and polish; these are sold to clients and provide an additional source of income.

PREPARATION AND TRAINING

Outlines have already been given in previous paragraphs of the training currently available for specific occupations and it will be noted that frequent reference has been made to "apprenticeships".

Apprenticeship takes many forms but often consists of systematic training on the job and extending over several years. It is first necessary to obtain employment where the practical side of the job will be taught by experienced workers. The theory of the trade, and complicated techniques, may also be taught by the employer but it is more likely that the apprentice will be required to attend a trade or vocational school during each year of apprenticeship. Some occupations are "designated" by provincial governments which means that the only method of entry is through a registered apprenticeship scheme; motor vehicle mechanic is typical of a designated trade—others are indicated on the chart "Apprenticeship Requirements" (page 110).

One of the main differences between apprenticeship and other forms of training is that you are paid while you learn. Pay scales are low at first but increases are given every six or twelve months until the full tradesman's rate is reached. In the case of formal apprenticeships, the apprentice enters into a written contract—known as an "indenture"—with an employer which states certain terms such as length of training, skills to be taught, pay scales and similar details.

It is possible to prepare for apprentice employment in the mechanical repair trades, while still in school, through "shop" courses designed primarily to teach manual and technical skills. Depending on the school and the course selected, training may range from machine-shop practices, welding and assembly work, to instruction in shop mathematics, chemistry, metallurgy or electricity. These courses also give students an opportunity to discover which type of mechanical repair work appeals to them most.

MECHANICAL REPAIR OCCUPATIONS — REGISTERED APPRENTICES
FEBRUARY 23, 1965

	MOTOR VEHICLE MECHANIC	BODY-AND-FENDER REPAIRMAN	DIESEL MECHANIC	HEAVY DUTY MECHANIC	STATIONARY ENGINEER	MILLWRIGHT	MACHINIST	GASFITTER AND STEAMFITTER	GASFITTER	REFRIGERATION AND AIR CONDITIONING	INSTRUMENT REPAIRMAN	AIRCRAFT MECHANIC	APPLIANCE SERVICEMAN	JEWELLERY AND WATCH REPAIRMAN	BUSINESS MACHINE MECHANIC
BRITISH COLUMBIA															
Apprenticeship—years	4D	4D		4D		4D	5D	5		5D			4D	5D	4D
*School Program	4-4-4-4	4-4-4-4		4-4-4-4		4-4-4-4	4-4-4-4	**		4-4-4-4-4			4-4-4-4	4-4-4-4-4	4-4-4-4
Minimum Education—grade															
No. Apprentices	393	127		228		16	197	43		31	13			20	10
ALBERTA															
Apprenticeship—years	4D	4D		4D		4D	4D	4D	3D	4D			4D		
*School Program	8-8-6-6	5-5-5-4		6-6-6-6			8-8-8-8	6-6-6-6	3-0-3	8-8-8-8			8-8-8-8		
Minimum Education—grade	9	9		9		9	10	9	9	9			10		
No. Apprentices	1,365	300		218		11	82	142		46					
SASKATCHEWAN															
Apprenticeship—years	5D	4D					4D			4D					
*School Program	8-8-9-9	6-6-6					8-8-8			8-8-8					
Minimum Education—grade	8	8					10			8					
No. Apprentices	383	59					3			14					19
MANITOBA															
Apprenticeship—years	5D	5D					5D	5D		4D					
*School Program	6-6-6-6	6-6-6-6					10-8-6-4	6-0-4-0		6-6-6-6					
Minimum Education—grade	10	10					9	9		10					
No. Apprentices	351	44					45	74		21					

ONTARIO															
Apprenticeship—years	5D	4D					4	5D		4 or 5				4	
*School Program	0-10-0-10							0-10-0-10		0-10-0-0-10				0-10-0-10	
Minimum Education—grade	10						10	10						10	
No. Apprentices	4,590			10		77	560	221		69	34			21	
QUEBEC															
Apprenticeship—years	4D		4D	4D		4D				4D		4D		4D	
*School Program	39-1-1-1		35-1-1-1	35-1-1-1		35-1-1-1				35-1-1-1					
Minimum Education—grade	7		7	7		7				7		7		7	
No. Apprentices															
NEW BRUNSWICK															
Apprenticeship—years	5D			4D	3 or 4	4D	4D	5		4D	4				
*School Program	39-**-**			39		39	32 total			39-**-**					
Minimum Education—grade	9			9	8 or 9	8	8	9		10	12				
No. Apprentices	340	108		110	32		38			1	70				
NOVA SCOTIA															
Apprenticeship—years	4D	4D		4D		4D				4D		5D			
*School Program	6-5-5-5	5-5-5-2		5-5-5-5						5-5-5-5		7-7-7-7			
Minimum Education—grade	9	9		9		9				10		10			
No. Apprentices	215	82		24	58		65	29		19		22			
PRINCE EDWARD ISLAND															
Apprenticeship—years															
*School Program															
Minimum Education—grade															
No. Apprentices	16														
NEWFOUNDLAND															
Apprenticeship—years	4D	4D	4D		4D	4D	4D				4D				
*School Program	8-6-4-4	8-6-4-4	8-6-4-4		8-6-4-4	8-6-4-4	8-6-4-4				8-6-4-4				
Minimum Education—grade	10	8	11		8	11	11				11				
No. Apprentices	116	46	16		41	8	16				1				

D Designated Trade. * Weeks of full-time attendance in each year of apprenticeship or equivalent. ** Evening or correspondence courses only

NOTE: This table is accurate at the time of going to press. However, many changes can be expected because of legislation to be introduced. Reference should be made to the Department of Labour in the respective province for additional information.

TABLE 1 — APPRENTICESHIP REQUIREMENTS

For those who have left high school, a wide variety of training opportunities are offered in trade and vocational schools. Considerable expansion is taking place in the area of vocational training at the present time and the following is a brief summary only. Trade or vocational school courses are currently available which are related to a specific occupation such as motor vehicle mechanic (in the province of Quebec, one year of vocational training is required before taking up an apprenticeship) or aircraft maintenance engineer (in the province of Alberta, completion of a two-year course in aircraft maintenance technology may be recognized as an exemption from the licencing requirements for a Maintenance Engineer's Certificate in Category "A"). Other courses provide the means of upgrading skills while in employment. In addition, special courses are placed from time to time on the curricula of trade schools when there is a shortage of personnel in a particular occupation.

Details of the facilities offered in a particular area should be obtained from the provincial Department of Education or the local office of the National Employment Service. It should be noted that financial assistance is available to approved applicants in the form of subsistence allowances, tuition fees, and unemployment insurance through the provincial Departments of Labour; again, the local office of the National Employment Service can supply full details.

Both day and evening classes are provided in the trade or vocational schools, those related to a specific occupation being of from six to ten months duration (full-time); all or a large proportion of this time may be deductable from the period of apprenticeship. It is also considered that these courses give a graduate an initial advantage when seeking employment.

For those who are unable to attend trade schools, or wish to upgrade their knowledge while in employment, correspondence courses are available in such subjects as drafting, mathematics or electricity which would be of particular value to those already employed in mechanical repair occupations, or related to a specific occupation such as power plant engineering. Courses are listed in the booklet, CANADIAN TECHNICAL AND VOCATIONAL CORRESPONDENCE COURSES, which is available in public libraries or can be obtained, free of charge, from the federal Department of Labour, Ottawa.

PERSONAL QUALITIES

There are certain attributes, in addition to the personal qualities which have already been given, which make the difference between the ordinary and the outstanding workman. Among these are honesty and integrity, cleanliness and orderliness—many repairmen enter homes and other premises—and the development of analytical ability in order to identify obscure faults quickly.

It is said that a good workman is a safe workman and nowhere is this more true than in mechanical repair occupations. In many instances, the repairman is not only responsible for his own safety but also for the safety of others—an aircraft maintenance engineer may be responsible for a multi-million dollar aircraft and the lives of one hundred passengers—and must perform all work, down to the smallest detail, in a careful and conscientious manner. If maintenance work is to be done efficiently, it is also essential that accurate records be kept. While repairmen may not be required to do the clerical work, in most instances the information is originated by them, therefore the ability to write a clear, concise report of work done and of record-keeping is essential.

ORGANIZATIONS

Workers in mechanical repair are covered by union agreements and are represented by affiliates of national and international unions. Other unions are active on an industrial or local basis. Selected as typical from the 1964 edition of LABOUR ORGANIZATIONS IN CANADA (published annually by the federal Department of Labour) are the following:

INTERNATIONAL UNION, UNITED AUTOMOBILE, AEROSPACE AND AGRICULTURAL WORKERS OF AMERICA—AFL-CIO/CLC

AMALGAMATED TRANSIT UNION—AFL-CIO/CLC

INTERNATIONAL ASSOCIATION OF MACHINISTS—AFL-CIO/CLC

NATIONAL METAL TRADES FEDERATION—CNTU

NATIONAL FEDERATION OF PULP AND PAPER WORKERS INC.—CNTU

INTERNATIONAL BROTHERHOOD OF PULP, SULPHITE AND PAPER MILL WORKERS—AFL-CIO/CLC

INTERNATIONAL CHEMICAL WORKERS' UNION—AFL-CIO/CLC

INTERNATIONAL UNION OF OPERATING ENGINEERS—AFL-CIO/CLC

NATIONAL ASSOCIATION OF MARINE ENGINEERS IN CANADA INC.—CLC

MARINE WORKERS FEDERATION—CLC

INTERNATIONAL UNION OF ELEVATOR CONSTRUCTORS—AFL-CIO/CLC

CANADIAN AIRCRAFT MAINTENANCE ENGINEERS ASSOCIATION

CANADIAN JEWELLERS ASSOCIATION

SEEKING EMPLOYMENT

Students while still in school should discuss their future plans with the school guidance counsellors. They are in a position to supply much more detailed information than can be included in a booklet of this size, especially on such subjects as the entry requirements and other details of trade and vocational schools and training courses which are available in local areas. This is a continuing service and information can be obtained from the guidance counsellors or placement officers of the National Employment Service .

Young people seeking their first job and older workers wishing to change occupations, can register with the local office of the National Employment Service, where they will be given every assistance in locating suitable apprenticeships or training situations. These offices can also supply much additional information such as employment prospects and future outlook, working conditions and pay scales in a particular area.

To obtain an apprenticeship, an applicant in addition to contacting the National Employment Service, can pursue one of the following methods: consult the provincial Director of Apprenticeship; locate an employer who is willing to hire an apprentice; or check want-ads in daily and weekly papers. Those seeking an apprenticeship or other employment can also apply directly to likely employers without reference to a particular vacancy and employment leads can be obtained from friends and relations already working in the occupation.

EARNINGS

Earnings depend on a number of factors including the size and policy of the employer, the location and the degree of responsibility in a particular occupation. In addition, a number of repairmen add to their income by the sales of new parts and equipment. Estimates of average earnings which should be used for general guidance purposes only are given in the tables which follow. These do not include fringe benefits such as overtime pay, vacations with pay, sick pay and pension schemes. The reader should refer to the local office of the National Employment Service, local employers and trade unions or to such publications as WAGE RATES, SALARIES AND HOURS OF LABOUR IN CANADA, published by the federal Department of Labour for current rates in a particular area.

	Canada Average	Newfoundland	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia
	Wage Rates Per Hour										
	$	$	$	$	$	$	$	$	$	$	$
Motor Vehicle Mechanic		1.80-1.85		1.70-1.95	1.50-1.90	1.50-2.20	1.50-2.35	1.70-2.35	1.95	2.15-2.25	2.40-2.55
Wheel Alignment Mechanic								1.65*			
Body and Fender Repairman		1.80-2.05		1.85-2.20	1.60-1.70	1.76-2.10	1.85-2.35	1.85-2.35	1.95-2.40	2.15-2.25	2.45-2.55
Diesel Mechanic		1.30-2.60*				2.05-2.40*	2.70-2.95*	1.90-2.70*	1.50-2.25*	2.10-2.80*	2.50-2.95*
Construction Equipment Mechanic								1.75*			
Stationary Engineer—											
4th Class		1.65-2.15		1.90-2.65	1.45-2.15	1.30-2.30	1.45-2.70	1.75-2.30	1.80-2.35	1.90-2.30	1.90-2.60
3rd Class		1.75-2.25		1.65-2.85	1.60-2.30	1.25-2.75	1.65-2.85	1.95-2.50	1.90-2.80	2.10-2.90	2.30-2.90
2nd Class		1.95-2.70		1.60-2.90	1.70-2.45	1.70-3.05	2.30-3.65	2.20-3.00	2.20-3.20	2.30-3.20	2.70-3.15
1st Class				2.45-3.05	2.10-2.55	2.25-2.75		2.55-3.00			
Millwright		2.30-2.90		1.85-2.05	1.70-2.30	1.50-2.85	1.75-2.90	1.95-2.80	2.10-2.40	2.05-2.70	2.40-2.80
Industrial Mechanic				1.70-2.50	2.10	2.30-2.75	2.50-2.80	2.11			2.50-3.10
Gasfitter							2.00-2.60*				
Refrigeration and Air Conditioning Mechanic											
Instrument Repairman				2.50-3.35		2.90*	1.60-2.55				
Aircraft Mechanic (depending on length of service)	2.35-3.10										
Aircraft Maintenance Engineer—											
A Licence (monthly)	445-490*										
B Licence (monthly)	500-750*										
R Licence (monthly)	500*										
D Licence (monthly)	500-750*										
Marine Engineer—											
4th Class (monthly rate)	475-525										
3rd Class (monthly rate)	445-550										
2nd Class (monthly rate)	510-652										
1st Class (monthly rate)											
Appliance Serviceman							2.00-2.10*				
Oil Burner Serviceman											
Watch Repairman											
Jewellery Repairman						1.90-2.25*					
Business Machine Serviceman				2.05-3.75*		1.60-3.25*	1.15-3.25*	2.00-3.05*		2.05-2.80*	1.85-2.80*
Elevator Mechanic							3.00-3.45*				
Vending Machine Mechanic							1.85-2.30*				
Pin Setting Machine Mechanic											
Locksmith						1.20-2.25*	1.50-2.00*				

Source: Wage Rates, Salaries and Hours of Labour, 1963.
*Estimates obtained from alternative sources including provincial surveys and Civil Service pay scales.

Note:
Rates for apprentices in designated trades range from 30 to 40 per cent of the tradesman's rate in the first year, and are increased by annual increments, to 90 per cent in in the final year of apprenticeship.

TABLE 2—WAGE RATES IN SELECTED OCCUPATIONS

		Canada		Nfld.		P.E.I.		N.S.		N.B.		Que.		Ont.		Man.		Sask.		Alta.		B.C.		Yukon and N.W.T.
		1951	1961	1951	1961	1951	1961	1951	1961	1951	1961	1951	1961	1951	1961	1951	1961	1951	1961	1951	1961	1951	1961	1961
Jeweller and watchmaker	(M)	3,882	4,431	27	39	17	8	105	109	82	79	1,129	1,598	1,562	1,665	238	223	144	128	192	217	386	363	2
	(F)	417	560	1	1	—	—	3	1	1	2	89	229	298	280	5	12	3	3	5	8	12	24	—
Mechanic and repairmen—aircraft	(M)	3,913	6,803	121	170	19	14	81	206	21	56	1,489	2,997	755	1,111	650	805	74	78	302	525	401	801	40
	(F)	12	24	1	—	—	—	1	1	—	—	4	17	5	4	—	—	1	—	—	1	—	1	—
Mechanic—motor vehicle	(M)	64,199	88,982	872	1,527	397	507	2,424	3,093	2,029	2,696	15,592	25,123	22,835	31,802	4,106	4,524	4,415	4,824	5,575	7,362	5,954	7,372	152
	(F)	129	149	—	1	—	2	3	—	4	1	29	57	78	53	2	8	3	4	4	8	6	15	—
Mechanic—railroad equipment	(M)	9,306	7,088	166	145	12	17	152	143	578	444	2,484	2,055	3,165	1,920	1,634	1,348	186	290	406	326	523	400	—
	(F)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mechanic—office machine	(M)	—	3,796	—	24	—	6	—	89	—	63	—	964	—	1,772	—	210	—	117	—	237	—	314	—
	(F)	—	48	—	—	—	—	—	—	—	—	—	14	—	27	—	4	—	—	—	1	—	2	—
Mechanics—N.E.S. (1)	(M)	52,677	73,315	706	1,000	99	207	1,648	2,502	842	1,420	14,431	18,497	24,303	32,092	1,900	3,030	1,399	2,041	2,724	4,492	4,625	7,798	236
	(F)	492	518	3	1	—	1	5	8	3	8	140	155	300	271	9	12	2	3	9	24	21	34	1
Millwright	(M)	8,055	9,781	132	191	3	—	185	217	298	408	1,976	1,823	3,701	4,632	141	169	53	75	117	310	1,449	1,953	3
	(F)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Stationary Engineman	(M)	25,586	29,427	372	667	43	59	844	997	630	849	5,882	6,136	11,080	13,225	1,119	1,365	792	1,004	1,604	1,724	3,220	3,276	125
	(F)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Engineering officers—ship	(M)	3,236	3,035	412	348	42	39	434	432	87	79	652	629	630	636	19	28	5	3	9	6	946	825	2
	(F)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Source: Census of Canada.

(M) Male (F) Female

(1) Grouping of miscellaneous mechanics, including those in air-conditioning; diesel, elevator, bicycle and coin-vending machine repair; gas and oil equipment service; locksmithing and gunsmithing.

TABLE 3—NUMBERS OF WORKERS IN SELECTED OCCUPATIONS

Distribution of Male Workers in Selected Industries, 1961

	Jewellers and Watchmakers	Millwrights	Aircraft Mechanics	Motor Vehicle Mechanics	Office Machine Mechanics	Railway Mechanics	Mechanics NES[1]	Engineering Officers, Ship	Stationary Enginemen
Mines, Quarries, Oil Wells	**1**	**295**	**20**	**620**	**4**	**41**	**5,586**	**10**	**1,431**
Manufacturing	**952**	**7,930**	**2,967**	**5,644**	**1,055**	**2,886**	**28,462**	**306**	**12,765**
Saw Mills	—	1,231	2	144	1	1	704	7	505
Pulp and Paper Mills	1	2,136	4	175	7	8	2,037	31	1,533
Iron and Steel Mills	2	1,010	2	89	5	30	861	1	453
Aircraft and Parts Manufacturing	5	89	2,879	47	3	3	455	—	135
Motor Vehicle Manufacturing	—	313	7	1,497	7	—	706	—	171
Railroad Rolling Stock Industry	1	49	1	57	1	2,789	216	—	90
Petroleum Refineries	—	17	2	106	2	—	561	18	720
Scientific and Professional Equipment Manufacturing	121	8	16	5	12	—	307	—	72
Jewellery and Silverware Manufacturing	779	2	—	1	—	—	27	—	19
Construction	**3**	**628**	**24**	**1,796**	**14**	**6**	**6,815**	**88**	**713**
Transportation, Communication and Other Utilities	**10**	**385**	**3,213**	**7,055**	**104**	**3,997**	**7,481**	**2,186**	**2,838**
Air Transport	—	54	2,923	41	1	3	230	—	60
Water Transport	1	6	1	21	1	9	151	1,997	91
Railway Transport	7	27	9	195	43	3,639	1,032	37	319
Truck Transport	—	—	1	2,798	1	12	329	6	23
Urban Transit Systems	2	7	1	1,602	1	300	368	10	71
Trade	**3,419**	**248**	**61**	**69,486**	**2,446**	**14**	**11,411**	**53**	**1,257**
Wholesale	164	217	56	4,490	2,340	12	6,950	45	731
Retail	3,255	31	5	64,996	106	2	4,461	8	526
Motor Vehicle Dealers	—	7	—	17,944	—	—	245	—	14
Motor Vehicle Repair Shops	1	3	—	36,436	3	—	167	1	8
Jewellery Stores	1,139	—	—	—	1	—	13	1	3
Watch and Jewellery Repair Shops	1,931	—	—	—	—	—	1	—	—
Community, Business and Personal Services	**14**	**50**	**59**	**519**	**84**	**3**	**6,322**	**19**	**5,296**
Education and Related Services	1	10	—	—	—	1	1,279	1	1,548
Health and Welfare Services	6	1	1	24	2	1	1,543	1	2,616
Public Administration and Defence	8	93	437	2,680	78	23	4,524	154	4,232
Defence Services	2	23	309	870	8	1	1,303	—	1,385
Local Administration	1	15	2	1,131	3	15	1,779	17	931

Source: Census of Canada.

(1)Grouping of miscellaneous mechanics, including those in air-conditioning; diesel, elevator, bicycle and coin-vending machine repair; gas and oil equipment service; locksmithing and gunsmithing.

TABLE 3 (continued)—NUMBERS OF WORKERS IN SELECTED OCCUPATIONS

Acknowledgements

Grateful acknowledgement is made to the following associations, trade unions, employers and government departments for their technical advice and co-operation during the preparation of this booklet:

AIR CANADA

ALGOMA STEEL CORPORATION LIMITED

BOWATER'S NEWFOUNDLAND PULP AND PAPER MILLS LIMITED

BROWN-BOGGS FOUNDRY AND MACHINE COMPANY LIMITED

BRUNSWICK OF CANADA LIMITED

CANADIAN AIRCRAFT MAINTENANCE ENGINEERS' ASSOCIATION

CANADIAN BUSINESS EQUIPMENT MANUFACTURERS' ASSOCIATION INC.

CANADIAN ELECTRICAL MANUFACTURERS' ASSOCIATION

CANADIAN JEWELLERS INSTITUTE

CANADIAN PACIFIC

CANADIAN REFRIGERATION AND AIR CONDITIONING ASSOCIATION

CANADA STEAMSHIP LINES LIMITED

CLARKE STEAMSHIP COMPANY LIMITED

CONSUMERS' GAS COMPANY

CORPORATION OF THE WATCHMAKERS AND JEWELLERS OF THE PROVINCE OF QUEBEC

CIVIL AVIATION BRANCH—
federal Department of Transport

DEPARTMENT OF ENERGY AND RESOURCES MANAGEMENT—
province of Ontario

DIRECTORS OF APPRENTICESHIP—
Department of Labour, Nfld.
Department of Labour, P.E.I.
Department of Labour, N.S.
Department of Labour, N.B.
Department of Labour, P.Q.
Department of Labour, Ont.
Department of Labour, Man.
Department of Labour, Sask.
Department of Labour, Alta.
Department of Labour, B.C.

DIRECTOR OF GUIDANCE—
Department of Education, N.B.

DIRECTOR, GUIDANCE SERVICES—
Department of Education, Ont.

DIRECTOR, EDUCATIONAL AND VOCATIONAL GUIDANCE—
Department of Education, B.C.

SUPERVISOR, PUPIL PERSONNEL SERVICES—
Department of Education, N.S.

SUPERVISOR OF GUIDANCE AND SPECIAL EDUCATION—
Department of Education, Sask.

SUPERVISOR OF GUIDANCE—
Department of Education, Alta.

DeHAVILLAND AIRCRAFT COMPANY OF CANADA LIMITED

ELEVATOR INSPECTION BRANCH—
Department of Labour, Ont.

FLIGHT STANDARDS AND REGULATIONS DIVISION—
federal Department of Transport

FORD MOTOR COMPANY OF CANADA LIMITED

GENERAL MOTORS OF CANADA LIMITED

GREYHOUND LINES OF CANADA LIMITED

GAS PROTECTION BRANCH—
Department of Labour, Alta.

GAS INSPECTION DIVISION—
Department of Public Works, B.C.

HEATING AND MAINTENANCE WORKERS UNION

HEINTZMAN AND COMPANY LIMITED

HENRY BIRKS AND SONS (MONTREAL) LIMITED

IMPERIAL OIL LIMITED

INTERNATIONAL ASSOCIATION OF MACHINISTS

INTERNATIONAL UNION OF ELEVATOR CONSTRUCTORS

JOHN INGLIS CO. LIMITED

JOS DOLAN AND SON LIMITED

KEN PARISIEN PIANOS LIMITED

MARINE WORKERS FEDERATION

MASSEY-FERGUSON LIMITED

MECHANICAL AND ENGINEERING DIVISION—
Department of Labour, Man.

MacMILLAN, BLOEDEL AND POWELL RIVER LIMITED

MARINE REGULATIONS BRANCH—
federal Department of Labour

NATIONAL ASSOCIATION OF MARINE ENGINEERS

NATIONAL CASH REGISTER COMPANY OF CANADA LIMITED

OTIS ELEVATOR COMPANY LIMITED

SHELL CANADA LIMITED

SMITH-CORONA-MARCHANT LIMITED

TORONTO TRANSIT COMMISSION

UNDERWOOD LIMITED

UNITED AUTOMOBILE, AEROSPACE AND AGRICULTURAL IMPLEMENT WORKERS OF AMERICA

VENDOMATIC SERVICES LIMITED

CANADIAN OCCUPATIONS FILM STRIPS

The Department of Labour has prepared to date, the following occupational film strips in collaboration with the National Film Board. A manual has been prepared as an accompaniment to each film strip. These may be purchased from the National Film Board, Box 6100, Montreal or from any one of its regional offices.

In Colour............................Price $4.00 each (In Canada)

- Office Occupations
- Careers in Engineering
- Careers in Natural Science
- Teacher
- Electronic Computer Occupations
- Careers in Library Service
- Medical Laboratory Technologist

Black-and-White.....................Price $2.00 each (In Canada)

- Bricklayer and Stone-Mason
- Plumber, Pipefitter and Steamfitter
- Sheet-Metal Worker
- Careers in Construction
- Machine Shop Occupations
- Printing Trades
- Motor Vehicle Mechanic
- The Social Worker
- Mining Occupations
- Draughtsman
- Careers in Home Economics
- Careers in Meteorology

MECHANICAL REPAIR OCCUPATIONS

Monograph No. 10